FLIGHT

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DIARY OF CURRENT AND FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in this list:—

1931

April 25. Sailplane Club's Dance, Suffolk Galleries.
April 27. "The Present Position in Aeronautics." Howard Lecture, by Dr. N. A. V. Piercy, before R. Soc. of Arts.
April 29. Closing date of British Empire Trade Exhibition, Buenos Aires.
April 30. "Aerodynamics of Sails." Lecture, by Dr. M. Curry, before R.Ae.S.
May 1-4. International Aviation Meeting, Pilsen, Czechoslovakia.
May 3. Flying Meeting. Southern Ae.C., Shoreham-by-Sea.
May 9. Flying Meeting, Bridgend, Glam.
May 9. Model Engineer Cup Competition, Sudbury.
May 14. "Metal-Clad Airship." Lecture, by C. Fritsche, before R.Ae.S.
May 14. "Petrol Engines for Models" Lecture by E. T. Westbury, before T.M.A.C., Junior Inst. Engineers, Victoria Street, S.W.1.
May 15-31. Stockholm Aero Show.
May 16. Reading Ae.C. Meeting.
May 23. Start of Whitsun Continental Cruise, Heston.
May 25-26. Northamptonshire Ae.C. Flying Meeting at Sywell.
May 30. Heston-Newcastle Air Race, for "Newcastle Evening World" Trophy.
June 6. Brooklands Air Meeting.
June 8. International Rally, Bucharest.
June 20. Flying Display and Air Pageant, Bristol Airport.
June 26. R.A.F. Dinner Club Annual Dinner.
June 27. R.A.F. Display.
June 27. Royal Air Force Display, Hendon.
July 8-11. Blackpool International Meeting.
July 10-19. Circuit of Italy.
July 25. King's Cup Race.
July 25. Rhön Gliding Competitions, Germany.
Sept. 5. Haldon Flying Meeting.
Sept. 12. Schneider Trophy Contest.

EDITORIAL COMMENT

A VERY useful letter has been sent to the Press signed by the Warden of the Guild of Air Pilots and Air Navigators of the British Empire and by eight other members of the Guild, who are engaged in instructing civilian pupils to fly aeroplanes. They plead that civil flying instructors should be licensed as such, and that only licensed instructors should be permitted to teach pupils to fly. The signatories to the letter start by saying that they feel it their duty to warn members of the public of the danger which they run in entrusting themselves for instruction in flying to those who are not properly qualified to give such instruction. The results of inferior training are brought to the notice of the public from time to time by unnecessary tragedies. The present system allows all and sundry to act as instructors, whether they have any experience or qualifications or aptitude for instructing or not, and this system must lead to a decline in the standard of flying, and consequently in the safety of all concerned. The recommendation put forward is that some means should be immediately devised to examine instructors in civil flying and to license those who are found competent, and that only those so licensed should be allowed to teach others to fly.

Civil Flying Training

The principle involved in this letter is certainly sound. It is only within fairly recent times that it has been recognised that teaching of any sort is an art, and that it can only usefully be practised by those who have the right temperament. In the days of Dickens' "Dotheboys Hall" an usher who had some book knowledge himself, was considered amply qualified to impart it to schoolboys. Now we have come to realise that the cleverest scholar is not necessarily, or even usually, the best teacher. The art of teaching is very different from the art of learning. The best teacher is one who has the right temperament, added to a sort of "knack" of imparting instruction in such a way that it is easily comprehended by the pupil and makes a lasting impression on his mind. This ideal teacher,

like your poet, is born and not made. But instruction in instructing, added to experience, can do much to make a useful teacher of a person who is not a heaven-sent genius in the art.

Perhaps it is easier to teach a practical subject to an adult than it is to teach book-learning to a child. Jones Minor does not want to learn the multiplication table, and an adroit mixture of compulsion and persuasion is necessary to drive it into his head. A full-grown man or woman, who pays to be taught flying at a school, presumably is very keen to learn as fast as he or she can. To that extent the task of the flying instructor is easier than the task of the schoolmaster. But the results of bad teaching may be much more disastrous in the former case than in the latter. Jones Minor, if badly taught, may fail to take as good a position in the world as his natural abilities should have entitled him to take. The badly-taught pilot may settle all problems of success in life in one moment of stalling near the ground.

When life and death hang upon the result of instruction, it seems quite wrong that any holder of a "B" licence should be able legally to undertake the teaching of flying. No other qualification seems to be demanded by the law. The "B" licensee is entitled to fly for hire or reward, and that covers paid instruction. Of course, no civil flying school of repute would engage a man as instructor merely because he held a "B" licence. Most of the civil flying schools stipulate for a C.F.S. certificate, at least in their chief instructor, and they take steps to satisfy themselves that all their instructors are really good at their work. But the point is that there is no legal obligation. There is nothing to prevent a "B" licensee from undertaking to teach flying, and we gather from the letter to which we have alluded above, as well as from our own observation of the bad flying of certain civil pilots, that at present there is a fair amount of bad teaching in the country. This ought to be stopped. We think that the Air Ministry, despite the risk of being once more called "grandmotherly," should take steps to stop it.

The lines suggested by the nine members of the Guild of Air Pilots and Air Navigators for putting an end to this abuse are eminently sensible. There ought to be another class of licence, a licence for instructors. It would not matter very much whether this licence were called "B2" or "C," so long as it produced the desired effect. Those who obtain this licence should be men who have been found fully competent to teach sound principles of flying in a way which will make the pupil into a reasonably good and safe pilot. No pupil should be given an "A" licence until he has been passed by one of these qualified instructors.

Of course, no legislation can prevent private tuition. Provided that there is no question of hire or reward (though the embargo upon these can be dodged without very much ingenuity), any pilot, or even one who, like Sir Hubert Wilkins, has never taken a ticket at all, may tell another how to work the controls of an aeroplane, and may give more practical instruction. The same thing often happens in the case of motor cars, though there it is not supposed to matter, as there is no driving test before a licence is issued. But a flying pupil who had been taught, and possibly well taught, by a friend, would not be able to get a licence merely by persuading a representative of the Air Ministry or the Royal Aero Club that he could do so many figures of eight. He would first have to satisfy one of the licensed instructors. This might seem rather like red tape, but it would be necessary (as many pieces of so-called red tape are) to keep the principle intact and to prevent abuses from creeping in. The principle is so important, and so much hangs upon good flying instruction, that an occasional anomaly would be a matter of small importance.

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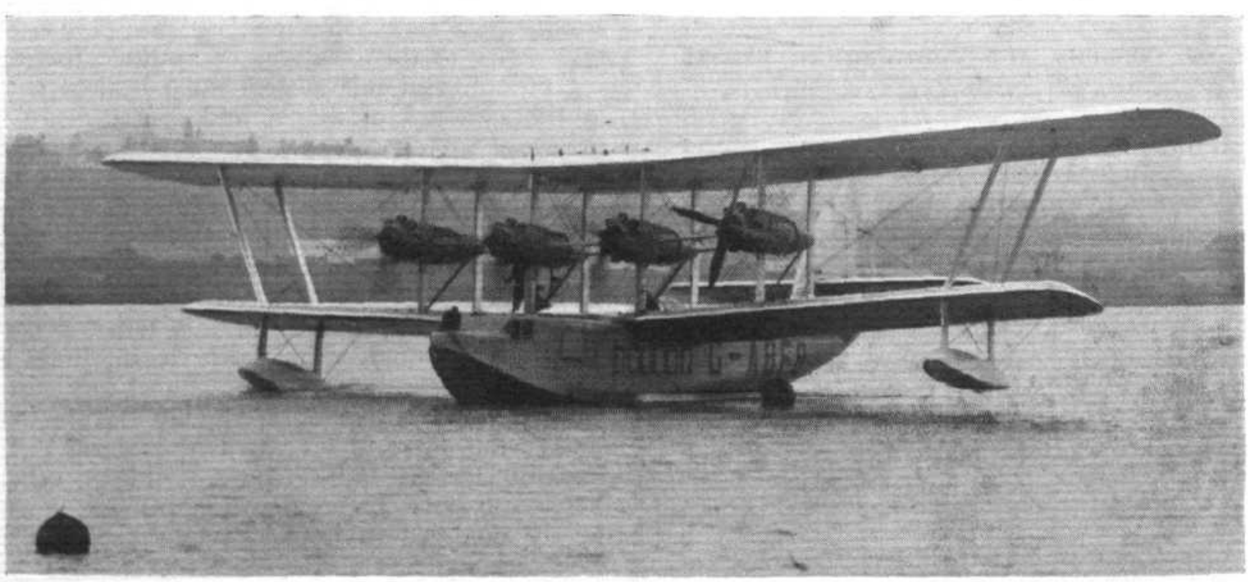
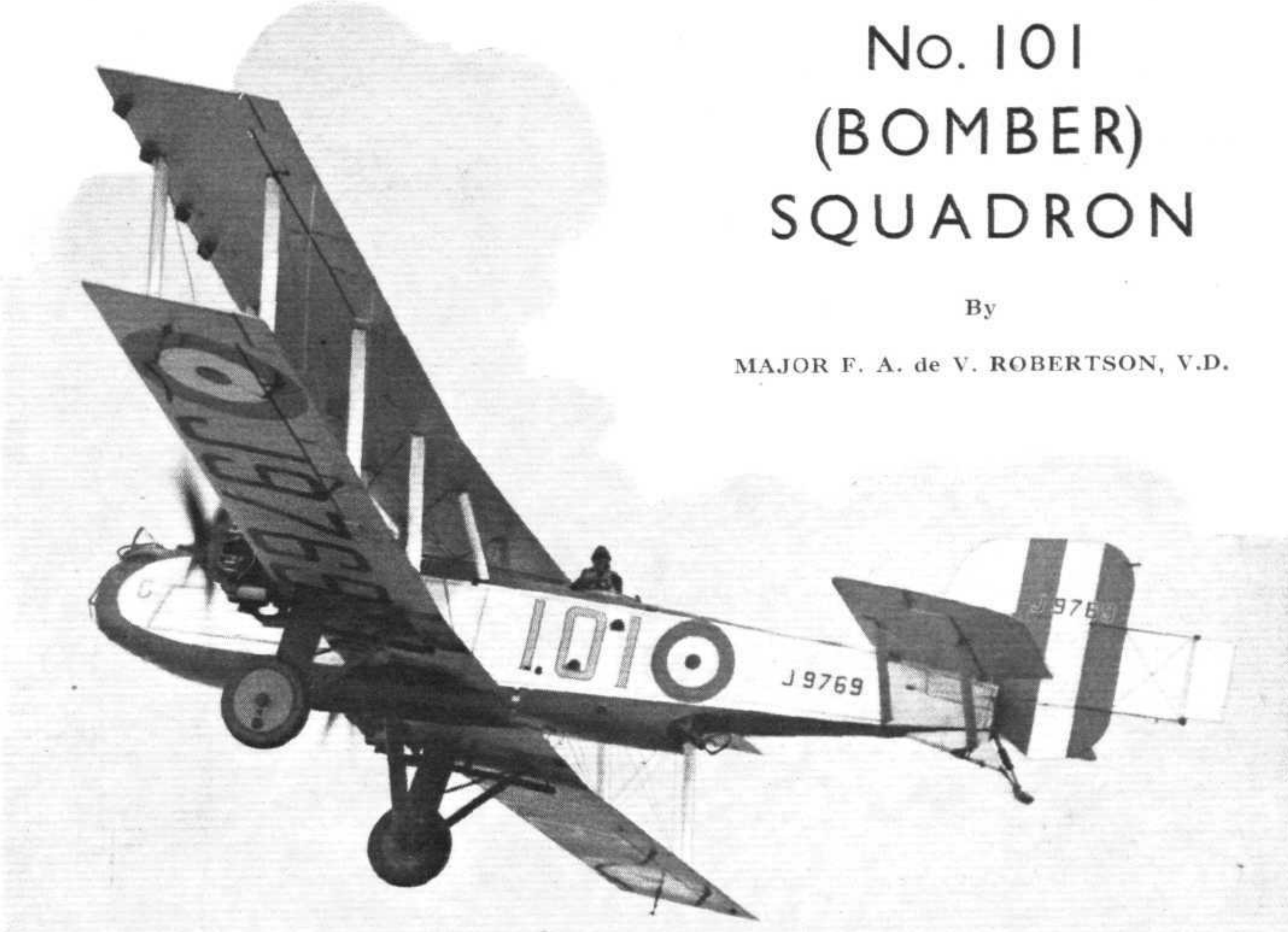


THE SECOND "KENT": Number 2 of the three four-engined flying boats built by Short Bros. for Imperial Airways has now been launched, and was paraded at Rochester early this week. The first machine of the "Kent" class was, it may be remembered, christened "Scipio." This second machine is named "Sylvanus," and the third, which is all but finished, will be named "Satyrus." The registration letters assigned to the three machines are: G-ABFA, G-ABFB and G-ABFC respectively. In this picture "Sylvanus" is seen at its buoy, starting the Bristol "Jupiter" engines. (Flight *Photo*.)



No. 101 (BOMBER) SQUADRON

By

MAJOR F. A. de V. ROBERTSON, V.D.

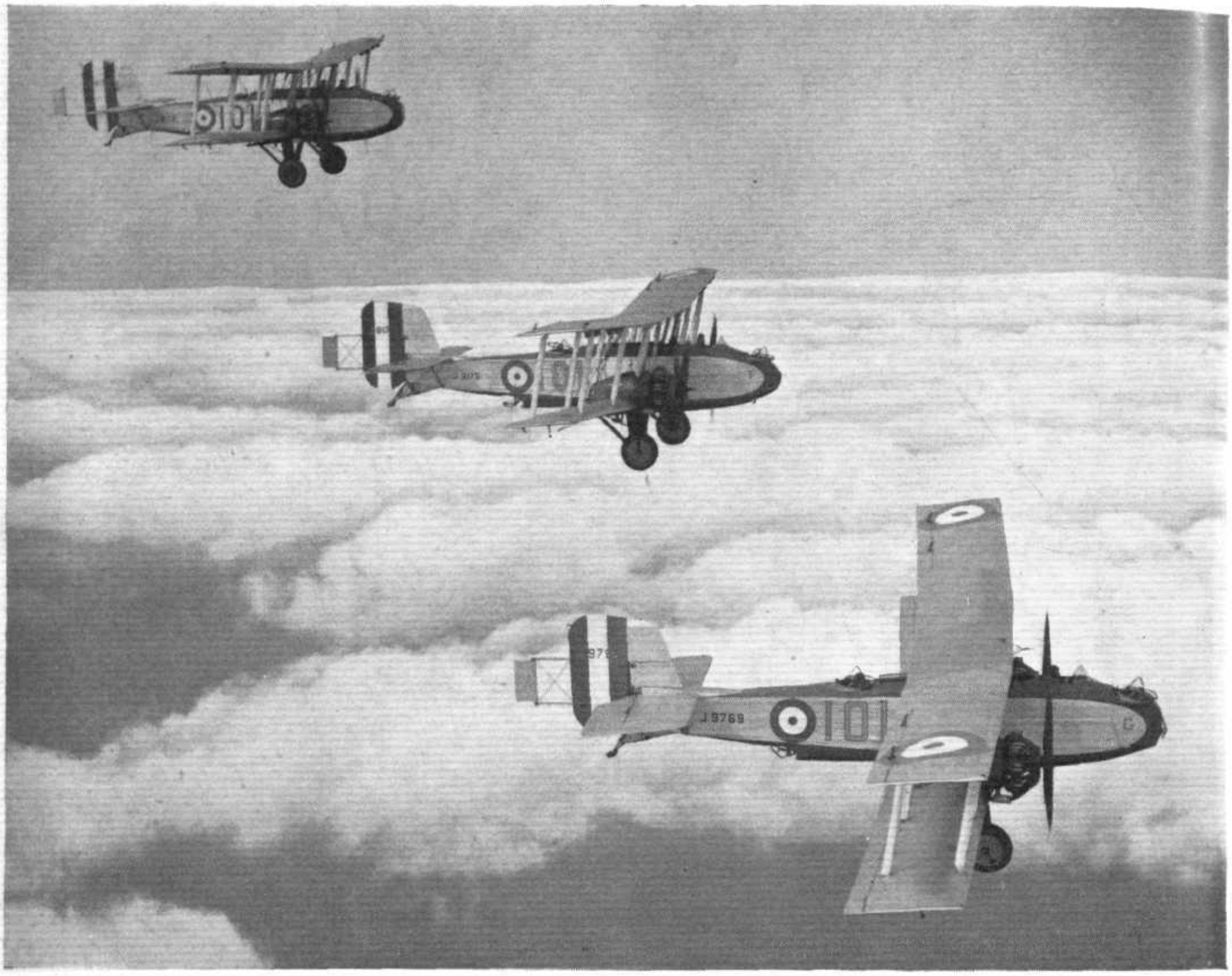
THERE is only one day-bomber squadron in the Wessex Bombing Area which is equipped with twin-engined aeroplanes. That is No. 101 (Bomber) Squadron, which is stationed at Andover, Hants., and the type which it flies is the Boulton & Paul "Sidestrand," driven by two Bristol mark 8F geared "Jupiters," with four-bladed propellers. The use of twin engines in a day-bomber aeroplane makes this squadron unique among all the units of the Royal Air Force.

By kind permission of the Air Ministry, representatives of FLIGHT were recently permitted to pay a visit to No. 101 B.S., and were most hospitably received by Squadron Leader F. H. Coleman, D.S.O., who has commanded the squadron since January, 1930, and by his officers. It may be added that the mess at Andover is a very pleasant and comfortable place, where the officers of the H.Q. Wessex Bombing Area, the Staff College, the Station H.Q., and the two day-bomber squadrons, Nos. 12 and 101, live together as a very happy family. Naturally, as No. 12 B.S. has very recently exchanged the famous "Fox" type for the still more formidable "Hart," there is a good deal of friendly rivalry between the exponents of the single engine and the twin as a medium of day bombing; but such rivalry is all for the good of the Service. The only feeling of regret which one experiences when visiting Andover is awakened by having passed Camberley on the road and seen the palatial style in which the Army Staff College is housed. The contrast between that and the makeshift erections with which the Royal Air Force Staff College is fain to be content makes one wish for a certain swelling of the Works and Buildings Vote in an early edition of the Air Estimates.

History of the Squadron

No. 101 Squadron has an honourable war history. Twin-engined bombers were not thought of for use by day when the squadron was formed at South Farnborough in July, 1917. Nor was the twin principle invariable for night use. No. 101 was formed as a night-bombing squadron, but the machine with which it was originally sent to France was the F.E.2.B. In those days training was intensive, both as regards pilots and also squadrons, but few units can have got themselves into fighting shape so rapidly as did No. 101. The formation commenced in July, 1917, and on the 25th of the same month the squadron went across to France. Its first C.O. was Major the Hon. L. J. E. Twisleton-Wykeham-Fiennes, who is now a Wing Commander and is Air Attaché at the Washington Embassy. He must have done great work in getting his squadron ready for the front so quickly. The first aerodrome which No. 101 occupied in France was St. André-aux-Bois. Of course it was moved a good many times before the war was over, but there would be little interest in recording here all the names of its aerodromes. The names of the successive Commanding Officers, however, are an interesting and honourable list. At the end of October, 1917, Major W. B. Hargrave took over the command. He is now a Wing Commander and an O.B.E., and he actually commands Andover station, where his old squadron lives. In July, 1918, Major E. L. Gower succeeded, and a month later he made over to Major J. Sowrey, now a Wing Commander, decorated with an Air Force Cross, and employed on the staff of the Air Defence of Great Britain. In January, 1919, Major S. W. Price took over, but only for a few days. Major W. J. Tempest commanded until No. 101 returned from France on March 16, 1919. Its last station in the war zone was Morville, in Belgium. In December, 1919, it was disbanded at Filton.

Before that happened the squadron went through stirring times. The work of setting off on bombing raids by night in a single-engined machine must always have been stirring. One wonders how men could have been found to make that their regular duty, night after night, for months on end. Of course, night-bombing squadrons were not likely to lose many men from combat in the air, but the uncertainty of what would happen if an engine failed must have been an ever-present nightmare. We find that the squadron in its 15 months at the front only lost seven men killed or died of wounds, 10 wounded, and 13 killed and seven injured from accidents. There were, however, 23 who were taken prisoners of war, which seems to indicate that the pilots of the squadron were very skilful, or else very lucky, in landing a F.E.2.B. at night behind the German lines when they could keep in the air no longer. The honours awarded to the squadron while at the front included four



Three " Sidestrands " of No. 101 (Bomber) Squadron flying in echelon. (Flight *Photo.*)

Military Crosses, nine Distinguished Flying Crosses, and four Meritorious Service Medals. On one occasion in September, 1918, during the final victorious advance of the Allied armies, the squadron was congratulated by Brigadier-General Charlton on the work it did one night in spite of very adverse weather, and on more than one occasion officers of the squadron were congratulated by Sir John Salmond, G.O.C., R.A.F. in France, for very fine pieces of night-bombing work. One of these was Capt. Halford. His objective was Busigny railway junction, and he flew down very low and got a direct hit on it, though the searchlights and anti-aircraft guns were very active. In addition to the congratulations of the G.O.C., the pilot received promotion for this exploit. A few months before, the same pilot had made three trips in one night to Bray and had dropped no less than 52 bombs on it.

The squadron had some curious tasks set it. One reads of it being sent out " noise drowning " for a tank advance in the last battle of the Somme. Machines at other times were sent out on tank patrols. Capt. Beeston was out once on a two hour tank patrol in very bad weather, and in the course of it he set out to bomb Levergies. The rain was heavy and the clouds were low, but he dropped his bombs all right, and then finished his tank patrol. He landed in very heavy rain after being three hours in the air.

One very extraordinary feat was accomplished by an observer, Lieut. Smith. The rule that two pilots might not fly in the same machine may have been justified by the exigencies of the time, when it was difficult to keep up the supply of pilots, and the idea of losing two in one catastrophe could not be tolerated by the authorities. But this rule put the observer in a very parlous position when anything happened to his pilot. In this case the pilot fainted when the F.E.2.B. was 10 miles beyond the German lines and facing eastwards. Smith, of course, could not fly a machine, but he had some knowledge of how to work the controls. He pushed the inanimate pilot aside, leant over, took hold of the joystick, and by a series of flat turns succeeded in turning the machine round in the direction of home. Then the engine began to give trouble, but Smith's resourcefulness was not yet exhausted. By a skilful use of the throttle, he succeeded in landing the machine safely on our side of the lines.

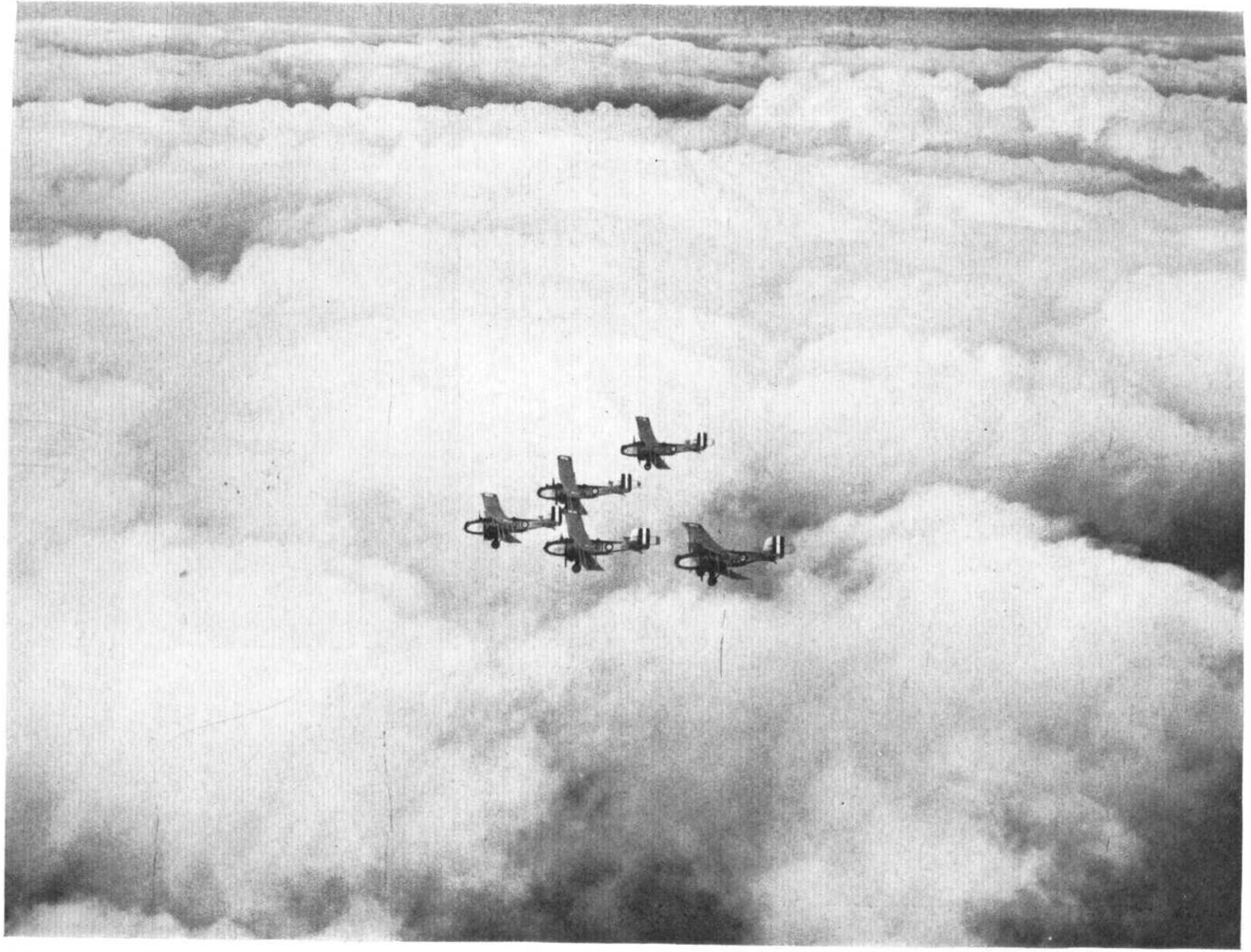
On another night in September, 1918, Capt. H. W. Stockdale, with 2nd Lieut. Shergold as observer, was out bombing when the machine was caught in a concentration of searchlights, from which the pilot could not escape. Then an anti-aircraft gun scored a direct hit on the engine, and that, one would have supposed, was the end of the fighting career of those two officers. Not a bit of it! Stockdale landed the machine safely in complete darkness, without the help of flares. The two officers were unharmed, though Shergold was badly shaken. They were 15 miles behind the German lines. They set out to walk back. Presently Shergold almost collapsed from exhaustion, and Stockdale had to half-drag, half-carry him. On the way they met a German officer, whom they felled. He was evidently left unconscious, though the records do not give details of what he was hit with or whether he was likely to recover. By a great piece of good fortune, that one officer was the only German whom they met. In time they reached the trenches, they got through a German trench, they crawled under the wire, they crossed no-man's-land, and they safely reached a British trench. For this Stockdale received well-deserved promotion.

Lieut. Anderson was another gallant observer. About a month before the Armistice he crawled out on to a lower wing of the machine he was in to drop the bombs by working the underneath releases. For this he too was congratulated by Sir John Salmond.

The Re-formed Squadron

In April, 1928, the Squadron was re-formed at Bircham Newton, under the command of Squadron Leader J. C. P. Wood, now a Wing Commander on the staff of No. 10 Group. From the first it was destined to use the

Five "Sidestrands" of No. 101 (Bomber) Squadron flying in formation above the clouds. Owing to the angle at which the photograph was taken, the aircraft appear to be closer than they really are. Ample room is left between them so that there shall be no risk of a collision.



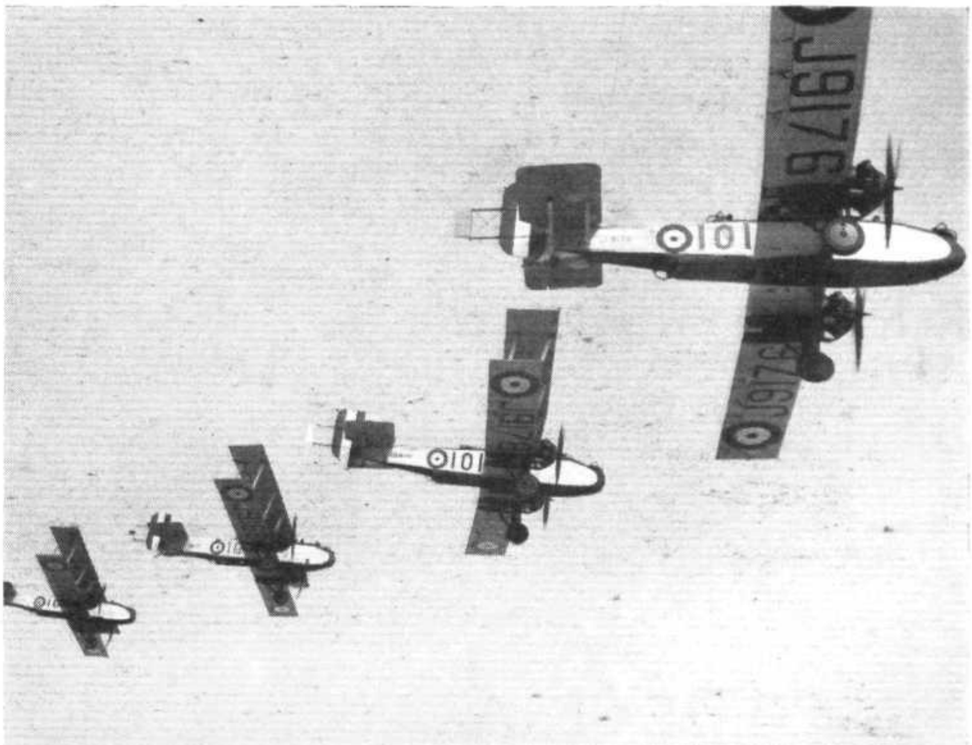
(FLIGHT *Photo.*)

PILOTS OF No. 101 (BOMBER) SQUADRON.

"Sidestrand," then a new production, in order to try out the effect of a twin-engined machine for day-bombing. It was, of course, a full scale experiment. It was some time before the squadron was fully equipped with its proper machines. Its establishment is a H.Q. and two flights, each flight possessing four machines, but usually working with only three. Single-engined squadrons, we may recall, have an establishment of a H.Q. and three flights. Moreover, at the present stage of the experiment, it is considered the correct tactics for a "Sidestrand" to work singly, as a night-bomber does. Formation flying is practised to some extent in case it should be needed, and our photographs show that No. 101 can keep formation as well as most squadrons. We remember, too, that during the Air Exercises of last summer a formation of "Sidestrands" made an effective raid on the H.Q. of Air Vice-Marshal Dowding at Cranwell. But, generally speaking, the idea is that a single "Sidestrand" should go out by itself on a bombing raid.

There is more than one reason for this. Naturally a single machine is not such a conspicuous object in the sky as a formation, and therefore it has a better chance of winning through to its objective than a flight or a complete squadron would have. A "Sidestrand" can carry a bomb load of 1,000 lb., and so even one is a formidable weapon of offence. Finally, the fighting powers of the "Sidestrand" are such that it is considered very well able to take care of itself. It has three machine guns, all of them movable. The pilot has no fixed gun, and the complications of interruptor gear are not necessary. There is one forward gun, one rear gun which fires upwards, and one rear gun which fires downwards. This gives a very extensive field of fire and leaves very few blind spots on the machine. None of the guns

The upper group shows the officers and airmen of "A" Flight, No. 101 (Bomber) Squadron. The lower group shows the officers and airmen of "B" Flight. (FLIGHT *Photos.*)



Four "Sidestrands" of No. 101 (Bomber) Squadron flying in echelon on the left. This view shows the position of the underneath gun very well, and also the absence of resistance from bomb racks, which are hidden within the contour of the fuselage. (FLIGHT *Photo*.)

is in the slipstream of a propellor. This is considered an important point. A gunner is naturally able to take a much more steady aim when he is not worried by a slipstream. The gun mountings, too, can be made simpler, and therefore easier to work. Important details such as these often make all the difference between a hit and a miss, and a single-seater fighter runs a particular risk when he attacks a "Sidestrand." During annual training nowadays certain fighter squadrons are affiliated to bomber squadrons to work out tactical problems together, and it is reported that two fighter squadrons have been very puzzled to arrive at a plan of attack on "Sidestrands" which would not involve risk of heavy casualties to themselves. The guns of a fighter are fixed, and the whole machine must be aimed at the target. The fighter is only dangerous when flying towards his target. When turning off after an attack, usually in a zoom with speed diminishing, he presents a more or less helpless target to the gunners on board the bomber. It is also considered that, apart from questions of slipstream, a twin-engined aeroplane makes a steadier platform for both gunnery and bombing than is afforded by a single-engined machine. Another point in the fighting equipment of the "Sidestrand" is its manœuvrability. It can be spun, looped, and rolled like a fighter, and this power would often enable it to escape from the aim of its assailants. Its high top speed and its good speed-range also help matters, for a sudden throttling down of the "Jupiters" would upset the calculations of the fighters as they dived to the attack. The "Sidestrand" can cruise at 120 m.p.h. with a crew of four and 1,000 lb. weight of bombs.

But, while fighting powers are very important to a bomber, a type must chiefly be judged by the efficacy of its bombing. The first essential is to carry a good load of bombs, and the "Sidestrand" will carry 1,000 lb. This is about double what the ordinary day-bomber can carry. The next essential is accuracy of aim. Bombing is becoming more and more of an accurate art—one might almost say, an exact science. The civilian who dreads outbreaks of "frightfulness" in the next war takes comfort in the thought that a pin-point target can still only be hit by good luck rather than by skill. But the most useful targets, namely aerodromes, railway junctions, factories and such like, can be seriously damaged and thrown out of gear even though the bomber and the bomb sights do not possess quite the accuracy of a King's prizeman at Bisley. Moreover, the British citizen, who perhaps has lost more than any other national through the coming of air power, should find his chief comfort in the thought (if it can be justified) that the aim of British bombers is more accurate than the aim of any possible enemies. In that lies his best hope of security.

"Brighter Flying"

No. 101 B.S. has shown in recent practice bombing at Catfoss that the accuracy of its bombing has reached a high and in fact an unprecedented standard. The squadron itself attributes this success, not to superior skill on the part of its own *personnel*, but to the merits of the "Sidestrand," especially since recent modifications have been incorporated in the machine. The twin-engined type is held to make a steadier platform for bombing. Recently the position of the man who releases the bombs has been changed. He used to lie prone on his chest inside the machine, a very uncomfortable position and one which did not produce the best results. Now he sits in a comfortable seat in the nose of the machine, in front of the pilot, and panels of glass have been inserted in the nose in front of him, through which he can actually see his target as the machine approaches the position from which the bombs are to be released. This is a great improvement and leads to much greater accuracy of aim. The mere fact that the man is more comfortable makes him more efficient. The bombs remain in the same position as before, suspended inside the outline of the fuselage and offering no resistance to the air. With all these advantages it is hardly surprising that No. 101 should have headed the list of day-bombers in the competitions at Catfoss in bombing, and in firing with the upward rear gun. Its results with the forward gun could not be classified, as the "Sidestrand" is the only day-bomber in which that gun is movable. One pilot and one airman of the squadron last year broke the Catfoss bombing record.

The "Sidestrand" is equipped with W/T but not with R/T. When its aerial is out, it can listen in to broadcast war signals, and can also tune in to the ordinary wireless programmes, which, as an officer remarked, makes for brighter flying. A very useful feature of the machine is its system of electrical inter-communication between the four men on board. The pilot, navigator and the gunners can talk to each other while they are in the air, which is an obvious advantage.

The "Sidestrand" is fast, though of course it is not so fast as the "Hart." It can also fly for a considerable distance on only one of its engines, provided that the engine which is *hors de combat* does not set up vibration. This would rarely have to be done with full load. Some fuel would certainly have been used up, and, once over enemy territory, all bombs could be jettisoned. The "Sidestrand" claims an advantage over the single-engined machine in flight endurance and in load of bombs, as well as in its capacity to go out alone on a bomb raid. The officers of No. 101 B.S. are enthusiastic believers in their aeroplane and in the principle which it embodies. Admittedly the twin-engined day-bomber is still an experiment, but those engaged in the experiment hold that it has proved a success, and that the future policy of Air Defence of Great Britain should lie in that direction. The authorities, of course, hear both sides, and the case for the single-engined day-bomber is doubtless put forward with equal ability by those who believe in it. The interest of such discussions and such experiments is intense, and the decision must have a profound effect upon the future policy and tactics of the Wessex Bombing Area and of Air Defence of Great Britain.

Capt. Frank Hawks arriving at Croydon. (FLIGHT *Photo.*)

THE TRAVEL AIR MODEL "R"

An American Commercial Aircraft with a Phenomenal Performance and the holder of Many Spectacular Records

THE Travel Air "Mystery Ship" with its phenomenal performance has been the subject of much conjecture and wild report since it has performed many astonishing flights in the hands of Capt. Frank Hawks, Lt. James H. Dolittle and Mrs. Florence L. Barnes. It first made its appearance at the National Air Races of America in 1929 at Cleveland, piloted by Douglas Davis, and created a sensation by doing one lap of the closed course at 228 m.p.h. A large number of record flights have since been made with this aircraft, notably those of the coast to coast record by Capt. Hawks which was made from the Glendale Air Port, Los Angeles, to Valley Stream, New York, on August 13, 1930, in 12 hr. 25 min. 3 sec., of which only 11 hr. 40 min. were flying time. Capt. Hawks also flew from Detroit to New York on September 30, in 2 hr. 41 min., and on October 7 he flew from Boston to New York in 54 min. 15 sec. and from Philadelphia to New York on October 9 in 20 min.

The Travel Air low wing model R., which is the correct name of this machine, makes use of the Wright 9 cylinder 450 h.p. engine, which, by the use of 6:1 compression ratio, high revolutions and a very low weight, gives this machine a low power loading. The engine is enclosed in a form of the widely advertised N.A.C.A. cowling, now called the Venturi cowl, which certainly decreases the drag to an enormous extent. In this case, preceding as it does the circular sectioned fuselage, the exit from the cowl would appear to have a very definite slot-like effect, and probably maintains a smooth flow for a long way back down the fuselage. Incidentally, the scale drawings, for which we have to thank our American contemporary *The Scientific American*, show that this fuselage is definitely swept inwards in the region of the pilot's cockpit, and this may possibly have some additional effect in reducing the drag much on the lines advocated by M. Poncelet in his little Monoplane. The engine mounting is of steel tubular construction, and is detachable, while the main fuel tank, of 86 gallon capacity, is constructed of aluminium, and is carried on the bottom longerons in the fuselage bay, directly behind the engine. A five gallon reserve tank is carried behind the main tank, and connected to it by means of a wobble pump. The engine feed is said to be by gravity through ½ in. pipe lines, but, judging from the drawings, the head achieved by this can hardly be up to British requirements.

The engine cowling, made of about 20 gauge aluminium, also has baffles between the cylinders, and the inner cowling, which extends back to the cockpit, is made of the same material.

The oil coolers are mounted on the stub wings, and the cooling fins are under the cat-walks.

Between the engine mounting and the tank there is, of course, the usual aluminium and asbestos fireproof bulkhead. The propeller used is an 8 ft. diameter standard steel one, set at a pitch of 22°.

The landing gear is reminiscent of the De Havilland Tiger Moth, except that the springing from each wheel is carried externally on a framework built round it, and is a combination of two oleo

SPECIFICATION OF THE TRAVEL AIR MODEL "R."

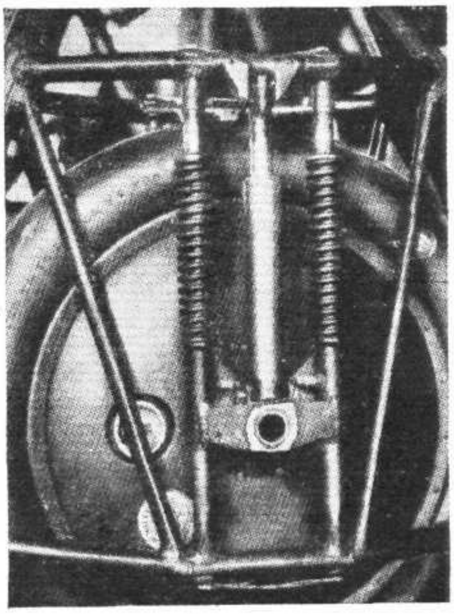
Length overall	20 *ft.* 2 *in.* (6·2 m.)
Height overall	7 *ft.* 9 *in.* (2·4 m.)
Wing section	*R.A.F.* 34
Span	30 *ft.* 0 *in.* (9·1 m.)
Chord	5 *ft.* 0 *in.* (1·5 m.)
Area of wings, total	125 *sq. ft.* (11·6 sq. m.)
Area of ailerons	12·3 *sq. ft.* (1·14 sq. m.)
Area of tail plane	14·1 *sq. ft.* (1·3 sq. m.)
Area of elevators	9·4 *sq. ft.* (0·87 sq. m.)
Area of fin	4·1 *sq. ft.* (0·38 sq. m.)
Area of rudder	5·7 *sq. ft.* (0·53 sq. m.)
Weight empty	2,000 *lb.* (907·2 kg.)
Gross weight loaded	3,300 *lb.* (1496·9 kg.)
Power Plant	450 *h.p. at* 2,400 *r.p.m.*
Wing loading	26·2 *lb./sq. ft.* (127·9 kg./sq.m.)
Power loading	7·3 *lb./h.p.* (3·3 kg./h.p.)
High speed (full load, sea level)	250 *m.p.h.* (402·3 km.)
Cruising speed	200 *m.p.h. at* 1,950 *r.p.m.* (321·9 km.)
Landing speed	60 *m.p.h.* (96·6 km.)
Take off run (still air)	300 *ft.* (91·4 m.)
Climb at sea level	3,200 *ft./min.* (16·2 m./sec.)
Service ceiling	30,000 *ft.* (9,144 m.)
Absolute ceiling	31,000 *ft.* (9,450 m.)
Fuel consumption at cruising speed	18 *gal./hr.* (81·8 litres/hr.)
Fuel capacity (normal)	96 *gal.* (436·4 litres)
Range at cruising speed	1,000 *miles.* (1609·3 km.)
Endurance at cruising speed	5 *hours (approx.)*

Capt. Hawks in his cockpit. The action of the sliding wind screen is plainly visible. (FLIGHT *Photo.*)

cylinders and four coil springs for each wheel. The wheels with this springing are braced to the outer ends of the wing stubs by N struts, and these struts are further braced by three streamline wires, which run outwardly to the wing spars with two others to the opposite wing stubs; finally, each wheel is encased in a streamline cover of about 20 gauge aluminium. Bendix wheel brakes are fitted.

A very short tail skid with a streamline shoe is sprung by means of a coil spring and oil dash-pot, and gives a ground angle of 13°. The wing itself is tapered in plan form and thickness, and is of R.A.F. 34 section, with the centre of gravity set at 24 per cent. of the chord. The wing bracing is by means of the already mentioned flying wires to the N chassis struts, and by similar streamline landing wires to the top of the fuselage. The wing is constructed of spruce and $\frac{1}{16}$ in. mahogany plywood, with which it is completely covered, and the spars are built up of spruce beams not spindled in any way. All metal fittings in the wing are of chrome molybdenum steel, and the compression ribs are boxed spruce ribs with plywood webs. The ordinary former ribs are of spruce with plywood gussets. The drag bracing is by means of tie rods, and these together with the plywood covering make the wing extremely rigid.

The ailerons are fabric covered and, constructed of chrome molybdenum steel, are attached to a false spar by three hinges, and the elevator, fin, rudder and tailplane are made with built-up steel tubular spars, stamped steel ribs, and are fabric covered. The fuselage is of welded steel tube and wedge shaped, faired out to a well rounded cross section and covered with $\frac{1}{16}$ in. mahogany three-ply wood, and the whole structure is tubular braced.



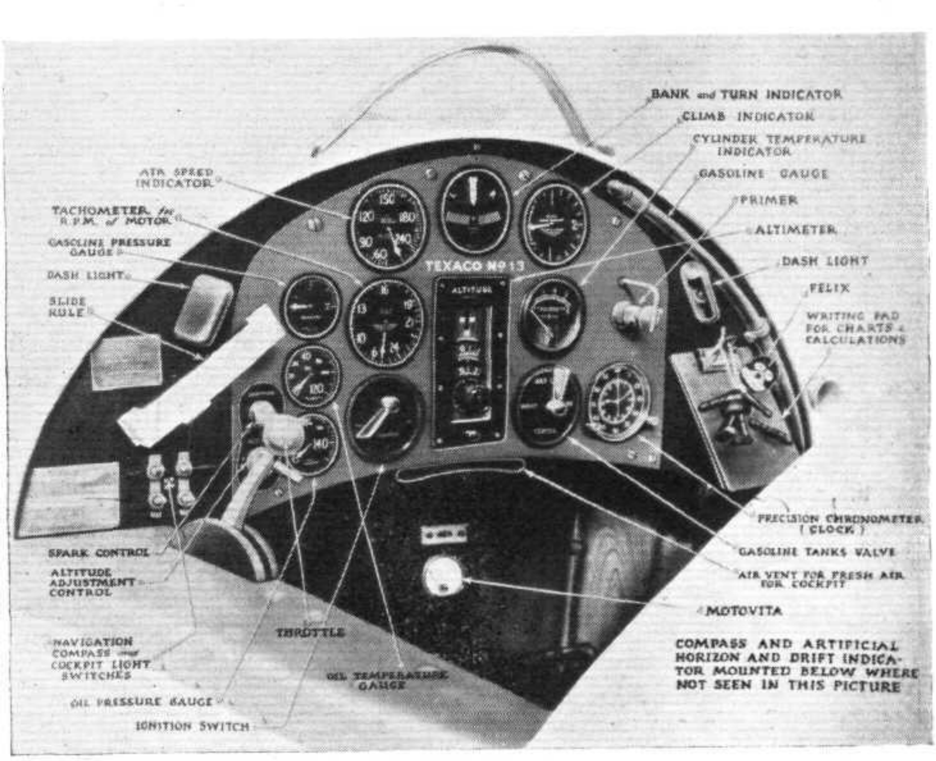
The self-contained oleo-cum-spring shock-absorbing mechanism for each wheel is understood easily from this illustration.

The ailerons are operated by a torque tube and a differential push and pull tube system, while cable control is used for rudder and elevators. The tailplane is adjustable in the air and the fin is adjustable on the ground.

Capt. Hawks, who is the aviation adviser in charge of the aeronautical activities of the Texas Oil Co., Ltd., whose registered office is at 125/130, Strand, W.C.2, is visiting Europe for the purpose of studying European flying conditions and conferring with the officials of the Texas Oil Co. in Europe regarding aeronautical matters. It is expected that he will remain over here two or three months. It is not his intention to make or break any speed records during his European visit, although he will undoubtedly make many rapid flights between various European air ports.

On Saturday, April 18, he landed at Croydon at about 3.20 p.m. after having left Brussels at four minutes past two. Afterwards he went on to Hanworth Park, where he was met by Col. Shelmerdine, the Director of Civil Aviation; Mrs. Shelmerdine; and Capt. the Hon. F. E. Guest; subsequently he flew to Heston, where he made a beautiful landing and thoroughly demonstrated the efficiency of his wheel brakes.

On inspection at Heston, the machine offered many interesting points. In looking into the cockpit, one of the first things one noticed was the slide rule on the port side of the dashboard. Whether any pilot flying across country at over 200 miles per hour would have time to use this would seem very doubtful, and presum-



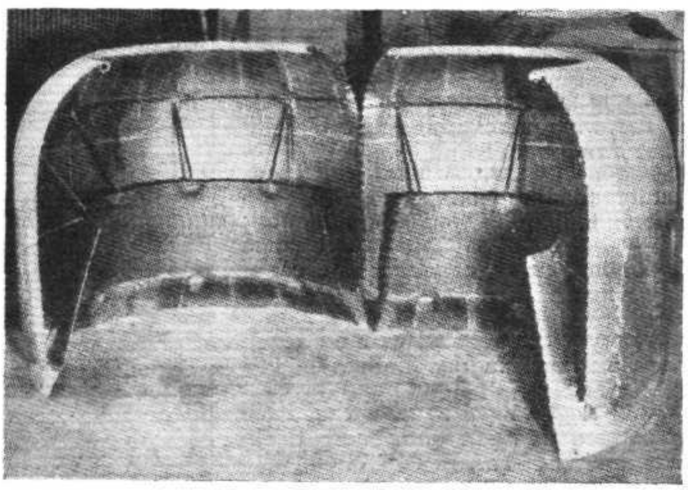
The Texaco No. 13 is used as a flying laboratory and consequently many special instruments have been fitted.

This view emphasises the cleanliness of the undercarriage, though many designers may not agree that wires in such a case produce less drag than a strut would. (FLIGHT *Photo.*)

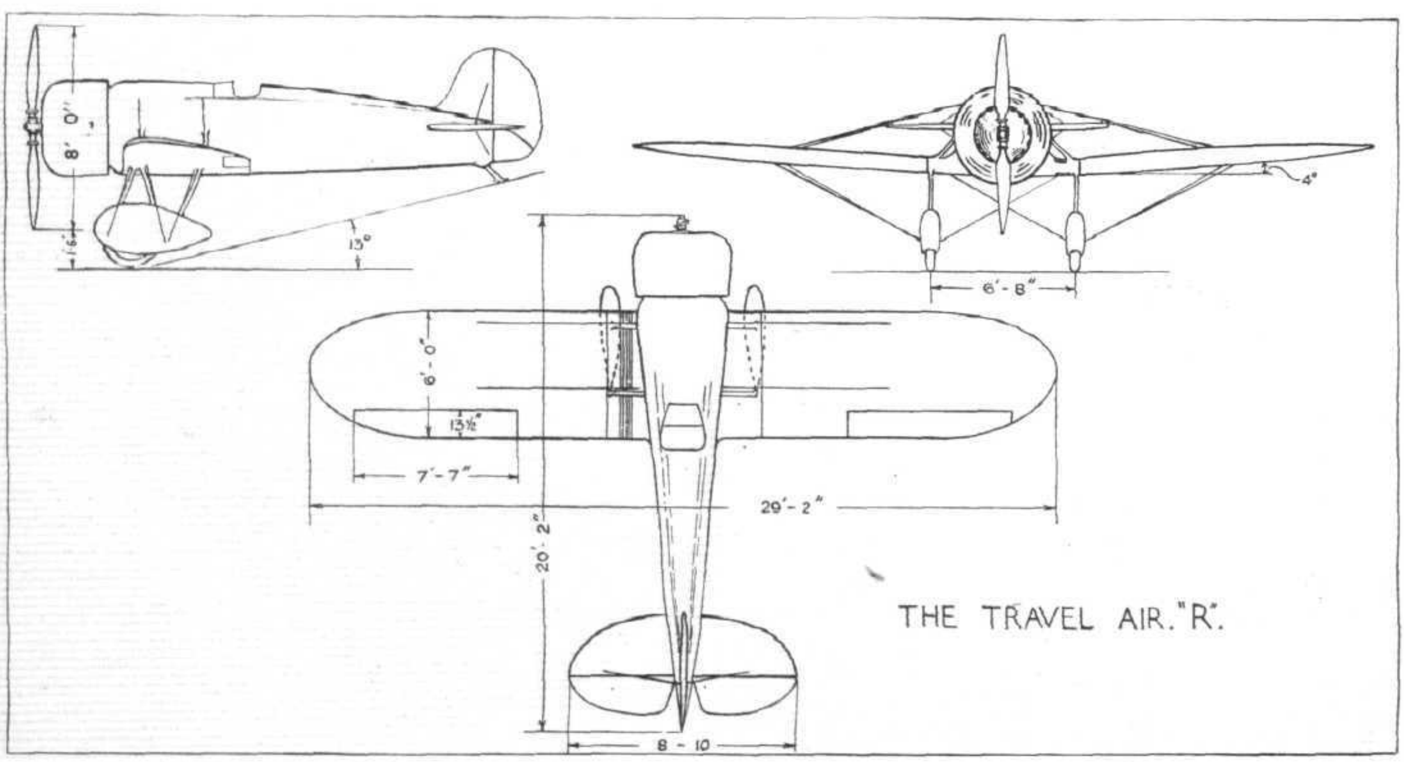
ably it is for this reason that this instrument is sealed with a lead seal. The sliding curved top of his wind screen was particularly interesting, and this apparently can be pushed forward where it acts as a normal, although very small, wind screen, or when it is desired to utilise the machine's speed to the full it can be pulled completely over the pilot's head. Each side of the cockpit is composed of a folding panel of fairly thick Cellon, through which the pilot gets a reasonable view of the surrounding country. This view is assisted by the inward sweep of the fuselage, of which we spoke at the beginning of this article.

At the tail end of the fuselage very neat telescopic handles are fitted for man-handling the machine on the ground, and these can be pushed right home so as to offer no drag at all when not in use.

The streamlining of all projections has been carried out very carefully, and all wiring lugs are completely encased in streamline fairings of papier-mâché or some other suitable substance. Similarly, the elevator, aileron and rudder hinges all have streamline caps over them. Under the same heading comes the complete very fine finish of the machine, and the result obtained with the lacquered fabric covering on the tail-surfaces should be of great interest to our manufacturers over here.



The Venturi engine cowling, which it can be seen consists of two distinct portions, is made of 20 G. aluminium sheet and plays an important part in decreasing the drag of the fuselage.



ne landing wires are stabilised by a short vertical le th of streamline wire above the front spar and a con- n ing rod to the rear wire.

he attachment of the engine cowling is interesting, and effected by means of straps which hook over a detach- le hinge at the front, and are secured at the rear by a nsion bolt.

The engine exhaust system is particularly interesting, as e stub exhausts are not extended outside the outer cowl- g ring and play direct on to asbestos sheets attached to he inside of the cowling. It would appear, therefore, hat the exhaust blast must very materially assist the cooling draught between this and the inner cowling and so around the cylinders. No doubt the blanketing effect of this outer cowling ring round the exhaust outlets accounts to a very large degree for the exceptional silence of the machine.

Navigation lights are another point where evidence is shown of great attention to detail, since they are of very small streamline shape and both on the wing tips and rudder are of the Duplex kind, that is, they show their appropriate lights on each side of the particular surface to which they are attached.

Capt. Hawks appears to be of that type of mentality which trusts its luck to fetishes which others consider un- lucky, since the registration letters and number of the machine is NR. 1313, while the Company's number in the shape of Texaco 13 is painted on the machine very prominently. A small map on the fuselage shows his route on his trans-Continental record flight.

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PRIVATE FLYING & CLUB NEWS

THE ASTON CLINTON OPENING:—The new sports and country club at Aston Clinton opened on Saturday last, April 18, with various special attractions, including a small flying display organised by Miss Sicele O'Brien. Instead of the usual arrival competition there was a form of treasure hunt which started from Hanworth, the competitors receiving clues which carried them round certain turning points, the nature of which had to be described on their final arrival at Aston Clinton. This was won by Mr. M. L. Bramson together with Mrs. Bramson in a Moth. There were some 15-20 machines present in spite of the exceptionally bad weather and the presence of much rain and snow. During the afternoon Mr. Murray gave an exhibition of aerobatics, and Flt.-Lt. Russell demonstrated the slow flying of the Redwing. The clubhouse itself is the old Victorian house built by Sir Anthony de Rothschild, and forms a most delightful setting for a club of this kind. The facilities provided include golf, tennis, squash rackets, hunting, riding, fishing, besides also the usual indoor amenities. Col. and Mrs. Shelmerdine were amongst those at the well attended opening lunch. The clubhouse is situated on the main Tring-Aylesbury road, and a small aerodrome had been arranged in a field adjoining the Halton aerodrome. Shortly after lunch Col. and Mrs. Shelmerdine left in one of the N.F.S. Desoutters for Hanworth, where together with Capt. the Hon. F. E. Guest they welcomed Capt. Frank Hawks, who came over in his "Travel Air" from Croydon. Capt. Hawks hopes to spend several days in residence at Hanworth club a little later on, so no doubt we shall be hearing more of his rather exceptional machine, which is described in detail this week. During the after- noon at Aston Clinton Mrs. Victor Bruce gave a short opening address and explained the reasons for using aircraft in conjunction with such a club, while after tea she gave away the prizes for the Treasure Hunt. These, which were a most beautiful assortment of fountain pens, were pre- sented with exceptional generosity by L. G. Sloan, Ltd., the makers of Waterman fountain pens. It was also recognised that the passengers could materially assist their pilots in a competition of this nature, and they, too, were rewarded with pens of various colours. These made very sensible and acceptable gifts, far better in fact than the usual small cups.

LONDON-NEWCASTLE AIR RACE:—The London-Newcastle Air Race, to be held on May 30 for the "Evening World" Trophy, is the only one of its kind ever held, it being 254 miles in length. Entry forms must be received not later than 5 p.m. on May 10, 1931, and can be obtained from the Hon. Sec., Newcastle Aero Club. A flying meeting will be held at Cramlington Aerodrome in conjunction with the race, at which any pilots who wish to go will be made welcome. Last year this race was run in conjunction with the King's Cup and was won by Miss Winifred Brown. This year it will be an entirely separate entity. The race itself is open to all makes and types of aircraft of unladen weight not exceed- ing 1,500 lb. and will be flown on handicap. The race will start from Heston and finish at Hanworth. No allowance will be made in the handicap for intermediate stops. The first machine will leave Heston at 1 p.m. Weight empty means total weight in flying order, that is, the weight of petrol, oil and crew not being included, but the weight of water in the radiators will count in the weight empty. The entry fee, payable at the time of making the entry, is £3 3*s*. per machine, while entries at £5 5*s*. will be received up to 12 noon on May 20. Competing aircraft must be at Heston for verification not later than 6 p.m. May 29.

FLYING IN NEW ZEALAND:—The Canterbury Aero Club held a meeting of their executive in Timaru on February 19. The president, Sir Francis Boys, was in the chair. A statement of the club's financial position on Feb- ruary 17 showed a credit balance of £1,512 11*s*. 4*d*., the income being £9,800 and the expenditure £8,288 4*s*. 2*d*. Their Instructor, Capt. Mercer, reported that club machines had flown 931 hr. during the last year, and that there were at present six pupils under instruction at Christchurch, four more at Ashburton, eight at Timaru, while the Washdyke ground was being put in order by the Borough Council.

THE BRISTOL AND WESSEX AEROPLANE CLUB:—The Bristol club put in a total of 109 hr. 30 min. for the month of March, made up of 42 hr. 30 min. dual, 44 hr. solo and 33 hr. passenger and test flying. The club's financial year ended on March 31, and the total flying time for the preceding year was 1,656 hr. 30 min., as compared with 1,057 hr. for the year before that. Amongst the latest acquisitions of the club is a Spartan Arrow (Gipsy I). This has been tried by many members, who have expressed great satisfaction at its flying qualities and the ease with which it can be handled. An order for a new squash rackets court has been placed with Carters, Ltd., London, and work will be started almost im- mediately. On Saturday, May 2, Henlys, Ltd., have arranged an Avian demonstration, when several machines will be sent down from Heston for this purpose.

BROOKLANDS SCHOOL OF FLYING has taken full advantage of the fine weather during the last fort- night, and amongst those who received trial flying lessons was Miss Ishbel MacDonald. The "Tatler's" flying scheme has brought a very large number of applications to the school, and the number of new pupils booked would seem to indicate that the season will be a record one. Amongst those who like to be well prepared for anything he undertakes is Mr. K. Murray, who has already made a complete circuit of the King's Cup Race course. Brook- lands is, quite apart from the school, in a state of perpetual activity, since the production Hawker "Furys" are coming out regularly now as well as several Vickers Virginias.

AIR SERVICE TRAINING LTD:—The new Air Service Training School at Hamble opened on April 14 with some 20 officers of the R.A.F. Reserve undergoing their annual training.

AN ALL-METAL TENDER FOR SEAPLANES

MANŒUVRABILITY : "Miss Birmabright" turns in not much more than her own length. The engine is a Morris "Commodore." (FLIGHT *Photo.*)

FOR a number of years the Birmingham Aluminium Casting Co. Ltd. have been developing a special corrosion-resisting aluminium alloy, to which has been given the trade name "Birmabright." This material, which is now obtainable in all the usual forms, such as sheet, extrusions and castings, has not hitherto come into general use in aircraft construction, but it is believed that in the near future its properties will be found useful for a variety of purposes.

"Birmabright" can, as already mentioned, be obtained in the form of castings, extrusions and sheets, and its mechanical properties, needless to say, vary according to the form. In the case of castings the yield point lies between 5 and 7 tons per sq. in., according to whether the bars are chill cast or sand cast. The ultimate stress lies between 9 and 15 tons per sq. in., while the elongation is $4\frac{1}{2}$-$5\frac{1}{2}$ per cent. for sand cast bars and 14-20 per cent. for chill cast bars. The corresponding Brinell figures are 54 and 58. Extruded sections in "Birmabright" have a yield point of 10-12 tons per sq. in., an ultimate stress of 16-19 tons, and an elongation of 15-24 per cent. The Brinell hardness figure is in the neighbourhood of 60.

In sheet form, the figures for "Birmabright" vary according to gauge, and cover the following ranges: Yield point, 7-20 tons per sq. in.; ultimate stress, 15-24 tons per sq. in. The elongation varies between the figures 4 per cent. in light gauges and 26 per cent. in heavy gauges. The Brinell figures lie between 58 and 86.

The composition of "Birmabright" has not been disclosed, but considerable corrosion-resisting properties are claimed for it. It is not, of course, claimed that the material is corrosion-proof, but it is fundamentally a film-forming alloy, so that when the surface is scratched it tends to "heal up." The usual anti-corrosion treatments can be applied to it, such as the anodic treatment.

Some time ago the Birmingham Aluminium Casting Co. produced a general utility launch built entirely of "Birmabright" alloy. This launch, which has now been standardised and is on the market, will, the makers believe, prove very serviceable as a tender for seaplanes, more especially for use in tropical climates where wooden construction may cause trouble owing to warping, shrinkage and consequent leaking, etc. As the launch has a speed of about 20 m.p.h. when fitted with the Morris 18/50 h.p. "Commodore" engine, it should be fast enough to be able to get to the aid of a seaplane quickly, while the seating accommodation (10, including driver) is such that passengers can be taken to and from a flying boat with a minimum of delay.

Last week "Miss Birmabright" was giving demonstrations on the Thames between Putney and Hammersmith, and the launch certainly appears to handle remarkably well. Short turns can be made at high speed, the launch banking automatically when the rudder is put over. While going astern, the launch answers the rudder well.

The "Neptune" model, of which "Miss Birmabright" is an example, is a hard-chine craft without steps. All three forms of the "Birmabright" alloy are used in the construction. The frames are in the form of castings, while extruded sections are used, sparingly, for various minor purposes, and the planking is, of course, in the form of sheet. The thickness of the planking is 3 mm. In order to give the "Birmabright" alloy a really thorough test in this particular launch, no protection whatever has been applied to the planking, although normally the anodic treatment is used. "Miss Birmabright" has, we are informed, been in commission for some 6 months, and certainly there were no signs anywhere of serious corrosion, so that when anodically treated the material should stand up well even in continuous service in sea water, so long as the anodic treatment film is not scratched, during beaching operations, for example.

The launch has a length of 22 ft., a beam of 6 ft., a depth of 3 ft., and a draught of 1 ft. 9 in. With complete equipment the price of the launch is £650.

For further particulars application should be made to Birmal Boats, Birmid Works, Smethwick, near Birmingham.

CRUISING : "Miss Birmabright" running very comfortably at some 15 m.p.h. The hull is of the hard-chine, non-stepped type, constructed throughout of "Birmabright" corrosion-resisting aluminium alloy. (FLIGHT *Photo.*)

The AIRCRAFT ENGINEER

FLIGHT ENGINEERING SECTION

Edited by C. M. POULSEN

April 24, 1931

CONTENTS

A GRAPHICAL METHOD OF STRESSING AEROPLANE SPARS.

By D. Williams, B.Sc., A.M.I.Mech.E.

(*Concluded from p.* 21)

II. Change of Moment of Inertia of Section

In case I it was seen that the locus line was shifted parallel to itself at each boundary line. A change of moment of inertia I, which results in a change in μ, produces no such shift, but merely has the effect of rotating the locus line through an angle depending on the magnitude of the change in μ. This will be illustrated by taking a main bay AB, in which two changes of I occur, as shown in Table II.

Referring to Fig. 4, draw the positive and negative sectors with angles α_1, α_2 and α_3. Assume Om_A positive, as usual. Draw the perpendicular at m_A to give the first locus line ll_1

Table II.

C ← B — l_{AB} — A

	3 (a_3)	2 (a_2)	1 (a_1)
	P	P	P
ASSUMED THAT	I_3	I_2	I_1
$\mu_2 > \mu_1$	μ_3	μ_2	μ_1
$\mu_3 < \mu_2$	α_3	α_2	α_1
		w = ZERO	

(Boundary lines: g between bays 3 and 2; f between bays 2 and 1.)

and the points f_1 and l_1. With f_1 as pivot ll_1 is rotated to the position ll_2 by taking any point y on ll_1, dropping the perpendicular yy_1 on f^1f, finding a point y_2, such that $y_2y_1/yy_1 = \mu_1/\mu_2$, and finally joining y_2f_1. The latter produced cuts the next boundary line in g_1, and the base line B^1B in n_1. At g_1 ll_2 is rotated in a similar way (*i.e.*, $z_2z_1/zz_1 = \mu_2/\mu_3$) to give the last locus line ll_3, which cuts B^1B in n_2 and makes an angle θ with it. This angle is measured. This time the movements of the locus line, as recorded by its point of intersection with B^1B, are not

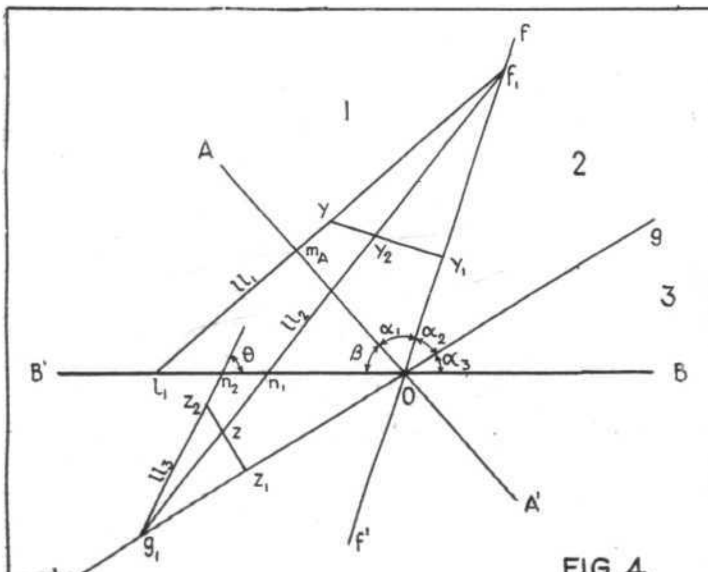


FIG. 4.

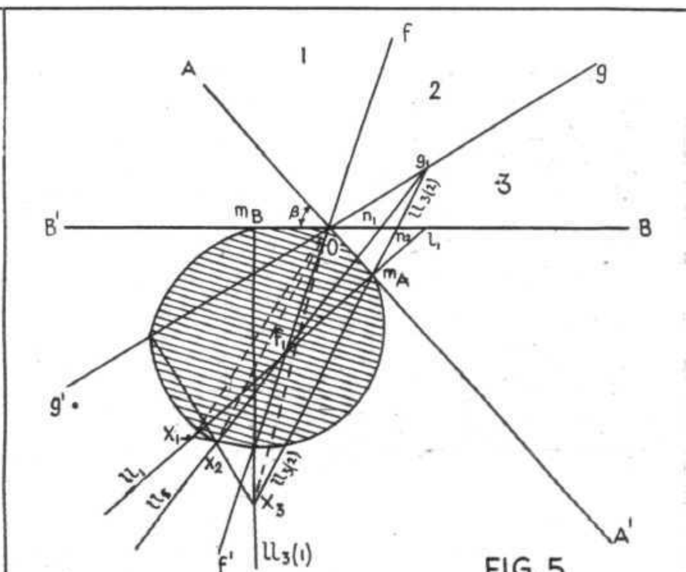


FIG. 5.

measured by the length of the intercepts l_1n_1 and n_1n_2, but by the ratios $\frac{On_1}{Ol_1}, \frac{On_2}{On_1}$ and our first equation is

$$\left(m_A \sec\beta \, \frac{On_1}{Ol_1} \cdot \frac{On_2}{On_1} + m_B\right) \tan\theta = -\frac{S_B}{\mu_B} = -\frac{S_B}{\mu_3}$$

and, as usual, the second equation is

$$Pi_B + S_B = \frac{M_B - M_A}{l_{AB}} + R_B$$

(In this particular case, since w is zero, and there are no concentrated loads, $R_B = o$).

The value of i_B is thus found in terms of M_A and M_B. Bay CB would be treated similarly to get another expression for i_B, and the standard procedure followed.

M_A and M_B, having been found by the above method, the actual B.M. diagram is drawn as follows :—

Referring to Fig. 5, draw the sectors and boundary lines as for Fig. 4. Suppose both m_A and m_B are negative. Lay off Om_A and Om_B in the negative directions of AA^1 and BB^1, and draw perpendiculars to give ll_1 and $ll_3(1)$ respectively. ll_1 cuts the first boundary line f^1f in f_1 and B^1B in l_1. Insert the points n_1 and n_2 using the ratios $\frac{On_1}{Ol_1}$ and $\frac{On_2}{On_1}$, as found in Fig. 4. Joint f_1n_1 to give ll_2, which cuts the next boundary line g^1g in g_1. Join g_1n_2 to give $ll_3(2)$. The latter cuts $ll_3(1)$ in X_3. Draw X_3X_2 perpendicular to g^1g, cutting ll_2 in X_2. Draw X_2X_1 perpendicular to f^1f cutting ll_1 in X_1.

OX_1, OX_2 and OX_3 are the diameters for the cutting arcs to be drawn in sub-sectors 1, 2 and 3, respectively. Since w is zero, the loading arcs shrink into the point O. The bending moments are shown shaded. In this case all the cutting arcs are below their respective loading arcs, which have shrunk into the point O, and, therefore, the bending moment is everywhere negative.

III. Combination of I and II.

Suppose a change of moment of inertia, a change of distributed load w and a concentrated load all occur together at a point in the main bay. Such a point will be a boundary line between two sub-sectors in the polar diagram, and the three types of discontinuity should be dealt with in the order just given, *i.e.*, the locus line is first rotated to account for change in I, then shifted along the boundary line, but parallel to its rotated position to account for the change of w, and finally moved along a perpendicular to the boundary line, still parallel to the rotated position to account for the concentrated load. All such movements of the locus line are recorded as points of intersection with the base line B^1B, and, as before, movements of the locus line parallel to itself are measured by the lengths of the intercepts on B^1B, while rotations are measured as ratios.

A single example applied to a bay AB will suffice to explain the procedure. The various quantities are tabulated in Table III.

Draw the sector and boundary lines and assume Om_A ositive as before (it is convenient to make this assumption always even if m_A is known to be negative). Erect a perpendicular at m_A to give ll_1 the first locus line which cuts B^1B in l_1 and f^1f in f_1. Rotate at f_1 to the position f_1n_1 but note that f_1n_1 is not the locus line ll_2 because the movements f_1f_2 and f_2f_3 which account for the change of w and the concentrated load respectively, have not yet been made. A line through f_3, however, parallel to f_1n_1 gives ll_2, the second locus line, which cuts the next boundary line g^1g in g_1, and B^1B in l_2. Rotate about g_1 to the position g_1n_2, measure g_1g_2 along, and g_2g_3 perpendicular to g^1g to obtain the point g_3. A line through g_3 parallel to g_1n_2 gives the last locus line ll_3, cutting B^1B in l_3, and making the angle θ with it.

Table III.

C ---	B 3	W_2 g 2	W_1 f 1 A
W_1, w_1 AND w_2 ARE $+ve$	a_3	a_2	a_1
W_2 AND w_3 ARE $-ve$	μ_3	μ_2	μ_1
LET w_2/μ_2^2 BE $> w_1/\mu_1^2$	α_3	α_2	α_1
$\mu_2 > \mu_1$	w_3	w_2	w_1
$\mu_3 < \mu_2$	w_3/μ_3^2	w_2/μ_2^2	w_1/μ_1^2

The first equation is written

$$\left\{\left(m_A \sec\beta. \; \frac{On_1}{Ol_1} - n_1l_2\right)\frac{On_2}{Ol_2} + n_2l_3 + m_B\right\} \tan\theta = -\frac{S_B}{\mu_B} = -\frac{S_B}{\mu_3}$$

the intercepts n_1l_2, n_2l_3 and the ratios On_1/Ol_1, On_2/Ol_2 being measured from the figure. Note that the intercepts and ratios must be written down in the above equation in the order in which they were obtained in Fig. 6.

The second equation is as usual :—

$Pi_B + S_B = (M_B - M_A)/l_{AB} + R_B$ and i_B is obtained in terms of M_A and M_B. The bay CB would be treated similarly, and the values of M_A and M_B would finally be obtained as described in the previous cases. The diagram is drawn as follows :—

Referring to Fig. 7, draw the sectors and boundary lines as for Fig. 6, and suppose that both m_A and m_B have been found to be positive. Lay off Om_A and Om_B to represent the numerical values of m_A and m_B to the scale chosen, and erect perpendiculars to Om_A and Om_B to give locus lines ll_1 and ll_3 (1) respectively. Let ll_1 cut B^1B in l_1 and f^1f in f_1. Insert on B^1B the points n_1, l_2, n_2, and l_3 in such a way that the intercepts n_1l_2, n_2l_3, and the ratios On_1/Ol_1, On_2/Ol_2 are equal to the values of these quantities just found in Fig. 6. Join n_1f_1 and through l_2 draw a parallel to give ll_2, which cuts g^1g in g_1. Join g_1n_2 and through l_3 draw a parallel to give ll_3 (2). This cuts ll_3 (1) in X_3. Through X_3 draw a parallel to g_3g_1 of Fig. 6 cutting the rotated position of ll_2 (*i.e.* g_1n_2) in z_2. Drop the perpendicular z_2z_1 on g^1g to cut ll_2 in X_2. Through X_2 draw a parallel to f_3f_1 of Fig. 6 to cut the rotated position of

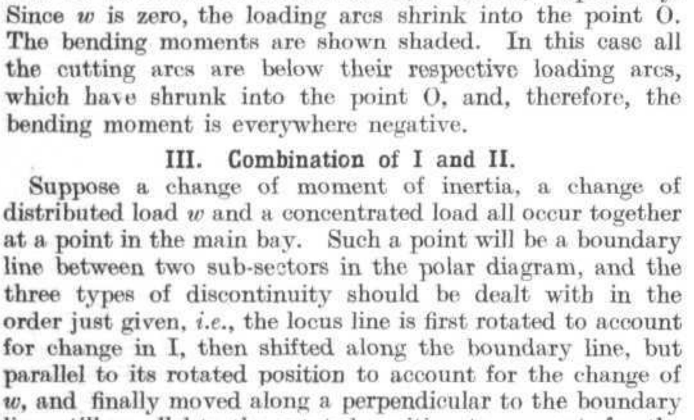


FIG. 6.

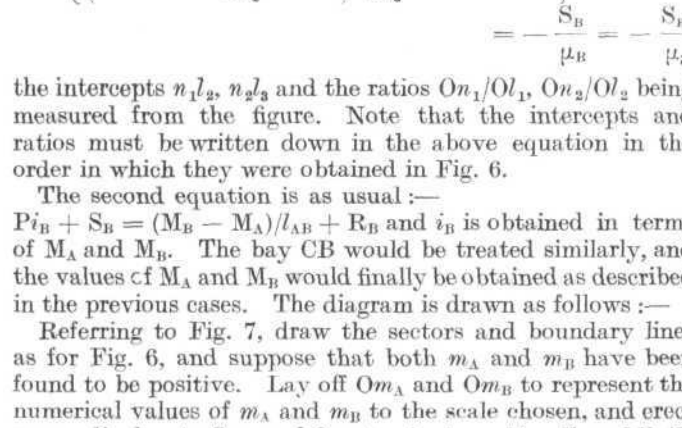


FIG. 7.

ll_1 (*i.e.*, f_1n_1) in y_2. Drop a perpendicular y_2y_1 on f^1f to cut ll_1 in X_1. OX_1, OX_2, and OX_3 are the three diameters for the circular arcs to be drawn in sub-sectors 1, 2 and 3 respectively. Draw these cutting arcs and then draw the loading arcs k_1k_1, k_2k_2, and k_3k_3 as described in Case I. The radial intercept between the two arcs gives the bending moment for any angular position of the radius.

It will be seen from the above construction that the first step is to draw the locus lines and their rotated positions, and so locate the X for the last sub-sector. Having found the position of X_3 on $ll_3(2)$ we can only obtain the position of X_2 on ll_2 by first using the rotated position of the latter. If ll_2 had not been rotated, $ll_3(2)$ would have been parallel to it, and X_2 would have been found directly by drawing a line through X_3 parallel to g_3g_1 of Fig. 6. The same thing happens when proceeding from X_2 to find X_1; it is first necessary to find the auxiliary point y_2 on the rotated position of ll_1 before the perpendicular y_2X_1 can be dropped on the boundary line f^1f to give X_1.

The above description may appear a little involved, but once the procedure is thoroughly mastered it is surprising how quickly a particular problem can be solved. It is important to use as large a scale as can conveniently be handled and to make all measurements with care.

Note.—In each of the above cases a figure has first been drawn with the object of obtaining the necessary data for the two equations and the positions of the locus lines, etc. The actual bending moment diagram has then, for the sake of clearness, been drawn separately. It is now pointed out that it may often be more convenient not to draw a separate diagram, but to make use of the first figure for the purpose of drawing in the actual bending moment diagram.

SHOCK ABSORBERS FOR AIRCRAFT LANDING GEAR.

By W. S. HOLLYHOCK.

THE most generally used shock absorbing media for aircraft landing gear are oil, air, rubber and springs. These are employed in a variety of ways, the two most common of which are combinations of oil-and-air, and oil-and-rubber. The all-rubber shock-absorbing unit is practically obsolete, and for various reasons, springs are not viewed with any great favour in this country, so it is not proposed to discuss either of these latter methods in detail in this article.

In both the oleo-pneumatic and oleo-rubber combinations, the oil serves the dual purpose of absorbing the shock of impact on landing, and of dissipating the energy so absorbed. The air and rubber on the other hand, give the necessary "cushioning" effect in taxying, and in certain cases also serve as factors of safety in the event of unduly harsh landings. Oil being incompressible, cannot store energy, and therefore cannot be used alone. Conversely, air and rubber being incapable of dissipating energy, need to be used in conjunction with oil to prevent bouncing of the aircraft when taxying, and to keep down the size and weight of the shock-absorbing unit.

Incidentally, it is chiefly in this respect that springs are not considered satisfactory, because a damping medium must be used in conjunction with them, and if oil is used the weight becomes prohibitive. The alternative is some sort of frictional device with its concomitant evils of wear and unreliability. The oleo-pneumatic combination is undoubtedly the best arrangement in every way. It is the lightest, offers the least aerodynamic resistance, and is more durable than others.

The big bogey of the pneumatic leg is the high air pressure necessitated. At least, it is considered an objection, though it is difficult to understand just why. Certainly accidents have happened, but aeroplanes have been known to break up in the air—and the aircraft industry has survived the shock. Actually, there is no reason why pneumatic cylinders should be any more prone to bursting than engine cylinders, and as regards accidents on the ground, these can be eliminated by rendering the unit foolproof—not a very difficult proposition. There is one other disadvantage about this arrangement, namely, the filling of the leg with air. This operation, if carried out by hand (as is usually the case) takes something like half an hour to perform. Nevertheless, to allow such a trivial matter to bias design would show a distinct lack of sense of proportion. As a matter of fact, if the unit is properly designed, the leakage will not be great so that frequent replenishing will not be necessary.

The principle on which all oleo combination units are based is the converse of the hydraulic ram acting either in advance of, or simultaneously with, an energy storage device. The unit consists of a cylinder containing oil and a piston which on impact forces the oil through a valve or small orifice. In the case of the oleo rubber arrangement the piston compresses the rubber after exhausting the cylinder of oil. In the pneumatic leg, the compression of the air may take place concurrently with the evacuation of the oil cylinder, or follow it, according to the type of leg concerned. It follows that such energy as is absorbed by the oil is actually dissipated; while that absorbed by the rubber or air is stored and given out again in the form of a rebound action. In this connection, it should be noted that the rebound action should be controlled by suitable stops and/or throttling of the oil passage to prevent the aircraft bouncing unduly when taxying. To this end, the rubber is initially compressed from one third to one half "g." With air, the higher figure should be taken (owing to its greater elasticity) if the two actions are consecutive as in the case of the rubber leg. Where the oil and air act concurrently, the air must, of course, be compressed initially to one "g" to ensure correct functioning of the oil valve. In all cases the return velocity of the oil must be controlled by throttling, though the amount of retardation is not of great importance except where the oil and air act concurrently—in which case, great care is necessary on account of the high air pressure acting on the piston.

With regard to the design of the oil valve—which, by the way, is usually of the needle variety—the cushioning effect of the tyres should not be taken into account. The amount of energy absorbed by the tyres, even when fully inflated, is not great and when they are deflated—a not unknown occurrence—obviously does not exist. So that if the leg is designed to allow for tyre effect, the aircraft will sustain a serious shock when landing on flat tyres. Whereas the effect of landing on fully inflated tyres with oleos not designed to take account of tyre resilience will be to ease, somewhat, the first shock of impact, though there must, of course, be a slight harshness when the tyres cease to deflect.

With regard to the actual design of compression rubbers for use in oleo-rubber units, it is not proposed to go into details in this article, as the matter has already been discussed in these columns. So long as the proportions of the individual rubbers are not freakish there is not much to choose between different shapes. The one really important requirement, of course, is a first quality material. Even so, they need to be carefully watched in service as they rapidly deteriorate—particularly under conditions of extreme temperatures.

With regard to oleo-pneumatic combinations, there are some important facts which should be borne in mind when designing such units. Firstly, it is absolutely imperative that the leg be so arranged as to be quite foolproof as far as the releasing of the air pressure is concerned. In other words, it must be so protected by locking devices, that it will not be possible for a mechanic to release any part in such a manner that it can become detached from the leg while there is any appreciable air pressure behind it—whether the leg is actually in place on an aircraft or not. The possible consequence of such an accident need not be elaborated if it is remembered that the air pressure may be of the order of 1,000 lb. per sq. in.

Secondly, owing to the high pressures attained, joints and glands need careful consideration in order to eliminate loss of pressure as far as possible. To this end, glands exposed to high air pressures should be so arranged that oil is present to keep them tight. In fact, it is really desirable to avoid glands exposed to air at high pressure, altogether, and it is quite possible to do so if the right arrangement is chosen. Joints which are exposed to high air pressure should be balanced by high oil pressure on the reverse side, where

possible, for the same reason. Where this is not feasible they should be thoroughly sealed, even at the expense of a little extra weight. In such cases it is a good idea to weld the joint if possible or even to go to the extent of machining out of the solid and thus avoiding a joint altogether, the latter method ensuring both absolute tightness and accuracy. Another point which might conceivably be overlooked, is the fact that in certain arrangements the piston rod decreases the effective volume of the oil cylinder and if the oil has to pass from one side of the piston to the other it may be necessary to extend the rod beyond the piston so that the volume on either side is unaffected by the movement of the rod.

The following example indicates the lines on which to proceed in the design of an oleo-pneumatic leg; and as the theory involved is similar, up to a point, to that of the rubber and oil combination, the one example will suffice for both. For the sake of simplicity, it is proposed to consider the design of a leg in which the oil is forced through a needle valve directly into the air reservoir without any piston or other separating medium between the oil and the air (see Fig. 1). Incidentally, it has been considered as an objection to this type that the oil is liable to froth on entering the air chamber. This, however, does not seem to be the case in practice—probably on account of the high pressure. In other respects, this type of leg has distinct advantages, in simplicity and lightness, over other arrangements.

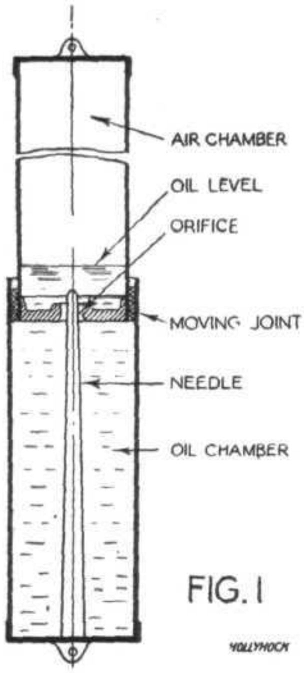


FIG. 1

Considering the normal type of aircraft with two compression legs, and taking the weight to be 10,000 lb. when fully loaded, the load per wheel at the moment of impact under conditions of level landing with tail up and acceleration of once "g," is equal to half the weight of the machine, that is, 5,000 lb. This is based on the perfectly tenable assumption that aerodynamic forces resist rotational movement for a fraction of a second.

Taking the maximum permissible load on the structure to be 3 × "g," the maximum load per wheel = 15,000 lb. If the vertical velocity of descent is taken as being 10 ft. per second (the usual figure) and the oleo absorbs 100 per cent. of the kinetic energy (*i.e.*, no allowance for tyre resilience)

then K. E., to be absorbed $= \frac{1}{2} \times \frac{5{,}000}{g} \times V^2 = 7{,}770$ ft.-lb.

To allow for one wheel landing, take $1\frac{1}{3}$ times this value (since the time elapsing before the other wheel touches will be very short).

Then K.E. $= 7{,}770 \times 1\frac{1}{3} = 10{,}350$ ft.-lb.

Since the maximum allowable load per leg may not be increased, the extra K.E. will necessitate increased travel of the wheel. Wheel travel $= \frac{\text{K.E.}}{\text{load}} = \frac{10{,}350}{15{,}000} = 0 \cdot 69$ ft. $=$ $8 \cdot 28$ in. Usually, it will be found that, owing to the geometry of the undercarriage, the travel of the oleo will not be the same as that of the wheel. Also, if there is any great difference, it will be necessary to plot the travels one against the other, to ascertain whether or not the ratio is constant throughout. If it varies greatly, the resistance figure of the oleo will have to vary accordingly, in order to ensure constant deceleration of the aircraft.

For this example, however, the ratio will be taken as such that for a wheel travel of 8·28 in. the oleo travel is 8 in. and will be assumed to be constant, so that the resistance figure for constant deceleration will be constant.

Therefore maximum load on oleo $= \frac{15{,}000 \times 8 \cdot 28}{8} =$ 15,500 lb.

Bursting of Cylinder Walls.

The maximum pressure at which it is permissible to work is a somewhat moot point. In the opinion of the writer, 2,000 lb. p.s.i. is not too high, though 1,500 is more general. For the purpose of this example, however, 2,000 lb. p.s.i. will be taken.

Using the following notation :—

p_a = air pressure (lb. per sq. in.).
p_o = oil pressure (lb. per sq. in.).
P = maximum load (lb.).
A_g = gross area of piston (sq. in.).
A_h = orifice hole area (sq. in.).
A_e = nett piston area $= A_g - A_h$,

at the end of the stroke,

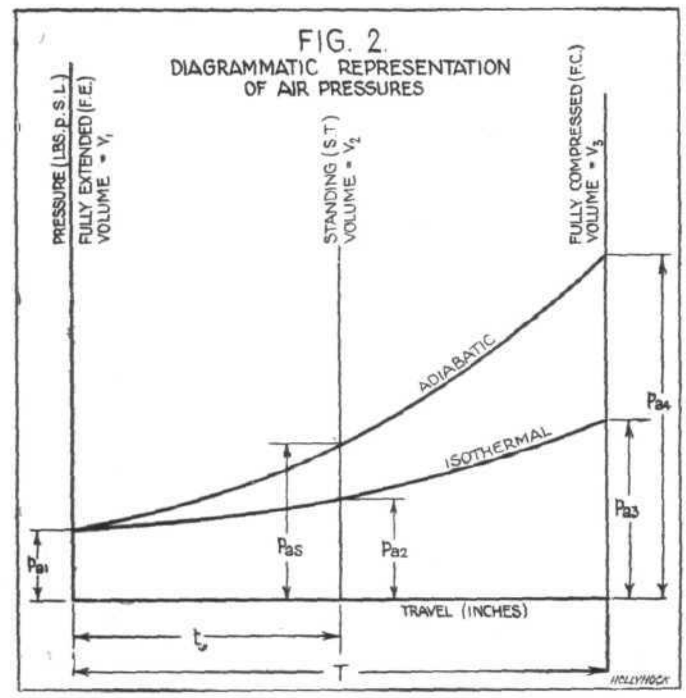
$$A_g = \frac{P}{p_o} = \frac{P}{p_a}$$

and

$$A_e = \frac{P - p_a A_h}{p_o} = \frac{P - p_a A_h}{p_a}$$

Since at the end of the stroke (*i.e.*, when fully compressed) $p_o = p_a$.

A_h should be kept as small as possible—consistent with a sufficiently rigid needle—in order that the orifice may be wide. If the orifice is very narrow it necessitates excessively fine machining limits on both the orifice hole diameter and the needle diameter, and makes absolute concentricity of the needle with the hole imperative. As the simplest method of fixing the needle is by screwing it into the base of the cylinder, this concentricity is not easy to obtain with a very great degree of accuracy.



If the orifice hole diameter be arbitrarily fixed at $\frac{3}{4}$ in. (this being a standard reaming size), $A_h = 0 \cdot 441$ sq. in.

$$\text{Then } A_e = \frac{15{,}500 - 2{,}000 \times 0 \cdot 441}{2{,}000} = 7 \cdot 309 \text{ sq. in.}$$

Hence $A_g = A_e + A_h = 7 \cdot 309 + 0 \cdot 441 = 7 \cdot 750$ sq. in., and cylinder diameter $= 3 \cdot 14$ in.

Therefore, maximum hoop stress developed in the cylinder walls $= \frac{p_a D}{2t}$ which, if the material is mild steel, may be taken as 60,000 and $t = \frac{2{,}000 \times 3 \cdot 14}{2 \times 60{,}000} = 0 \cdot 0524$ in. Say, $\frac{1}{8}$ in. This gives a factor of safety of nearly $2\frac{1}{2}$.

Actually, the initial oil pressure is slightly greater than at the end of the stroke, but the difference is negligible when a reasonable factor of safety is allowed.

Air Volumes and Pressures.

If the static load on the tail skid is 10 per cent. of the weight of the aircraft, the static load on one wheel will be 4,500 lb. Static load on oleo is, therefore, $\frac{4,500 \times 8\cdot 28}{8}$

$= 4,650$ lb.

Let—

$P_{a1} =$ Air pressure with leg fully extended (F.E.)
$P_{a2} =$,, ,, ,, ,, in standing position while stationary.
$P_{a3} =$,, ,, with leg fully compressed (F.C.) assuming a static condition.
$P_{a4} =$,, ,, with leg fully compressed in action.
$P_{a5} =$,, ,, with leg in standing position during action.
$V_1 =$ Air volume with leg fully extended.
$V_2 =$,, ,, ,, ,, in standing position.
$V_3 =$,, ,, ,, ,, fully compressed.
(See Fig. 2.)

Then $P_{a1}V_1 = P_{a2}V_2 = P_{a3}V_3$ (Isothermal compression)

and $p_{a1}V_1^n = p_{a5}V_2^n = p_{a4}V_3^n$ (Adiabatic compression)

$$p_{a2} = \frac{4,650}{A_g} = 600 \text{ lb. p.s.i.}$$

At F.C., since velocity is zero, p_d ($=$ pressure difference $= p_o - p_a$) $= 0$.

Also, $P_{a1}V_1 = p_{a2}V_2 = p_{a2}(V_1 - A_g t)$ where t is the travel of the leg from F.E. to standing position (S.T.) and $p_{a1}V_1^n = p_{a4}V_3^n = p_{a4}(V_1 - A_g T)$ where T is the total travel of the leg.

Hence, $p_{a1} = p_{a2}\left(\frac{V_1 - A_g t}{V_1}\right) = p_{a4}\left(\frac{V_1 - A_g T}{V_1}\right)^n$

Therefore, $\frac{p_{a2}}{p_{a4}}\left(\frac{V_1 - A_g t}{V_1}\right) = \left(\frac{V_1 - A_g T}{V_1}\right)^n$

or $\frac{p_{a2}}{p_{a4}}\left(1 - \frac{A_g t}{V_1}\right) = \left(1 - \frac{A_g T}{V_1}\right)^n$

Let $\left(1 - \frac{A_g T}{V_1}\right)^n = x$, $n = 1\cdot 3$

and $\frac{p_{a2}}{p_{a4}}\left(1 - \frac{A_g t}{V_1}\right) = y$

Then values of x and y can be plotted for various values of V_1, and where the two curves intersect will be the true value of V_1 for the particular case under consideration (see Fig. 3). With regard to the ratio $\frac{t}{T}$, this will be fixed automatically in cases where the oil and air function consecutively; but where the actions are concurrent—as in this example—it must be determined arbitrarily. The factors to bear in mind in fixing it are that the greater it is (i) the smaller the air chamber and, consequently, the lighter the unit and (ii) the harsher the action in taxying. So that, as is usual in aircraft design, a compromise must be made. Generally speaking, a value of $0\cdot 5$ is sound and this figure will be taken in this example.

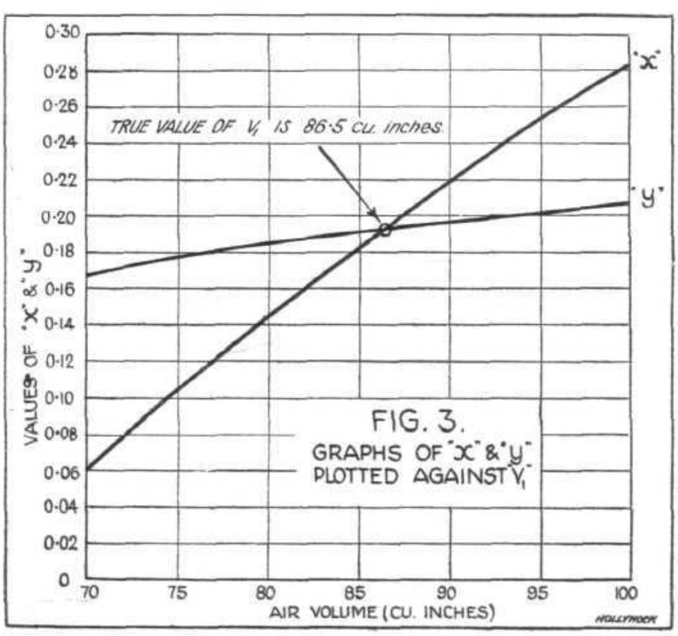


FIG. 3.
GRAPHS OF 'x' & 'y' PLOTTED AGAINST V_1

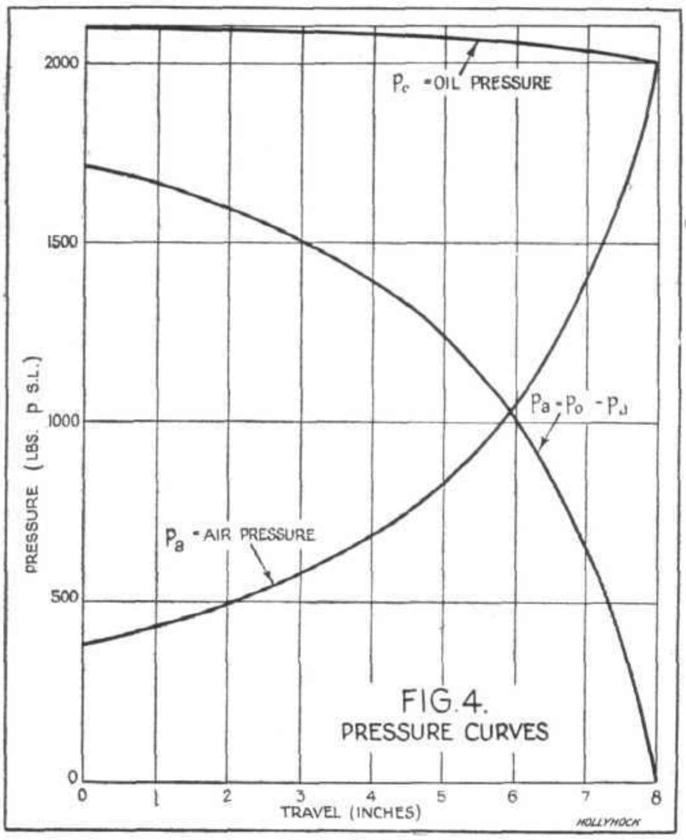


FIG. 4.
PRESSURE CURVES

All pressures and volumes can now be deduced as follows :—

$V_1 =$ volume at F.E. $= 86\cdot 5$ cubic in.

$V_2 =$,, ,, S.T. $= V_1 - A_g t = 86\cdot 5 - 31 = 55\cdot 5$ cubic in.

$V_3 =$,, ,, F.C. $= V_1 - A_g T = 86\cdot 5 - 62 = 24\cdot 5$ cubic in.

$p_{a1} =$ pressure at F.E. $= \frac{p_{a2}V_2}{V_1} = \frac{600 \times 55\cdot 5}{86\cdot 5} =$ 385 lb. per sq. in.

$p_{a2} =$,, ,, S.T. (Isothermal) $= \frac{4,650}{7\cdot 75} =$ 600 lb. per sq. in.

$p_{a5} =$,, ,, ,, (Adiabatic) $= p_{a1}\left(\frac{V_1}{V_2}\right)^{1\cdot 3} =$

$$385\left(\frac{86\cdot 5}{55\cdot 5}\right)^{1\cdot 3} = 686 \text{ lb. per sq. in.}$$

$p_{a3} =$,, ,, F.C. (Isothermal) $= \frac{p_{a2}V_2}{V_3} =$

$$\frac{600 \times 55\cdot 5}{24\cdot 5} = 1,358 \text{ lb. per sq. in.}$$

$p_{a4} =$,, ,, ,, (Adiabatic) $=$ 2,000 lb. per sq. in.

The Oil Valve.

The frictional resistance of the oil in passing through the valve and also the friction of the mechanical parts, will be neglected. It is not possible to calculate these and, in any

case, they will be partially nullified by the fact that the compression of the air is not truly adiabatic—since some heat must inevitably be dissipated—and the air pressure will consequently be lower than calculated. The ultimate error, therefore, is not of great magnitude.

Applying the usual hydraulic principles, the velocity-pressure equation may be written :—

$$\frac{p_d}{62 \cdot 4S} = \frac{V^2}{2_g}\left(\frac{A_e}{A_o}\right)^2$$

Where—

p_d = pressure difference = $p_o - p_a$
p_o = oil pressure (lb. per sq. ft.)
p_a = air pressure (lb. per sq. ft.)
s = Specific gravity of the oil used = $0 \cdot 95$ (say)
V = Velocity of compression of oleo = vertical velocity of aircraft × ratio of oleo travel to wheel travel (ft. per second)
A_e = Nett area of piston (sq. ft.)
and A_o = Area of orifice (sq. ft.)

$$\text{Hence} \quad A_o^2 = \frac{V^2}{2_g} \times \frac{A_e^2}{p_d} \times 62 \cdot 4 \times 0 \cdot 95 \text{ sq. ft.}$$

$$\text{or} \quad A_o^2 = \frac{V^2}{2_g} \times \frac{A_e^2}{p_d} \times \frac{62 \cdot 4 \times 0 \cdot 95}{144} \text{ if } A_o \text{ and } A_e$$

are in sq. in. and p_d is in lb. per sq. in.

$$\text{Therefore, } A_o = 0 \cdot 584 \frac{V}{\sqrt{p_d}}$$

Allowing for a coefficient of discharge of $0 \cdot 8$, this equation becomes $A_o = 0 \cdot 731 \dfrac{V}{\sqrt{p_d}}$

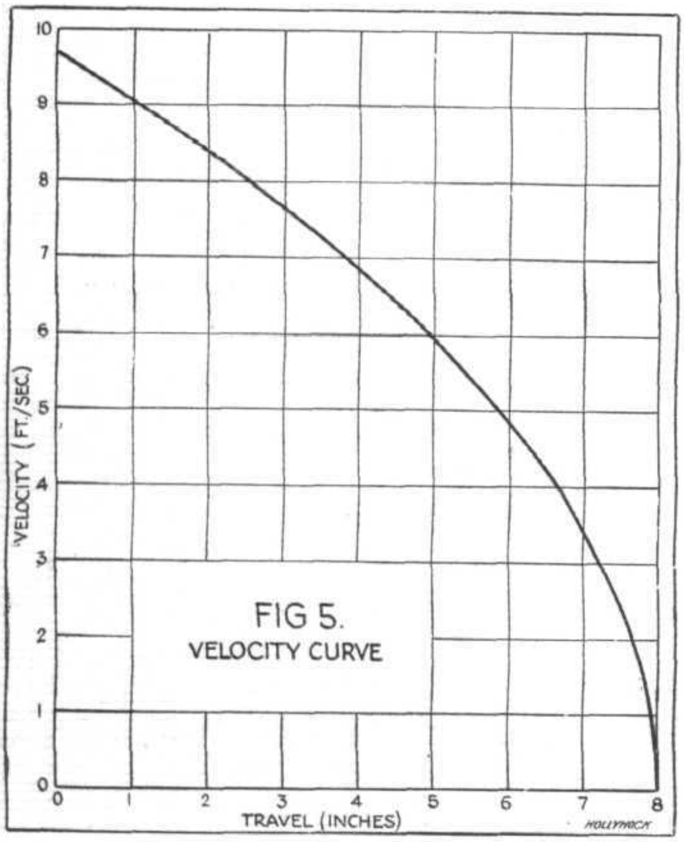


FIG 5.
VELOCITY CURVE

Incidentally, it should be borne in mind that, in order to obtain a high value of co-efficient of discharge, the orifice must have a good entry at each end, and must not be either unduly long or excessively short.

It is now necessary to determine the values of V and p_d.

Since the deceleration is constant, $V^2 = u^2 + 2fs = o$ at F.C.

$$\text{Hence } f = -\frac{u^2}{2s} = -\frac{10 \times 8}{8 \cdot 28 \times 2T} = -70 \text{ ft. per sec.}^2$$

Therefore, the velocity at any instant is determinable.

The load on the oleo is constant since the resistance is constant.

$$\text{Hence, load} \quad = 15{,}500 = p_o A_e + p_a A_h$$

$$\text{Therefore, } p_o \quad = \frac{15{,}500 - p_a A_h}{A_e} = 2{,}120 - 0 \cdot 0604\, p_a$$

$$\text{and } p_d \quad = p_o - p_a = 2{,}120 - 1 \cdot 0604\, p_a$$

Having obtained these equations, it is now possible to find the needle diameter at any point.

In plotting the necessary curves, intermediate points at say, a quarter and three quarters of the travel should be interpolated in order to obtain the curves more accurately and also to check the other values (see Figs. 5 and 6).

It is also as well to plot the pressure curves as a cross check on the calculated values of p_d (see Fig. 4).

The values of the various factors should be tabulated as follows (the sequence of the columns indicating the order of working out) :—

Position.	Travel (In.).	Velocity. (Ft. per sec.)	Air pressure. (Lbs. p.s.i.).	Oil pressure. (lbs. p.s.i.)	P_d.	A_o sq. in.	An = Needle area (sq. in.)	Needle diameter (in.)
F.E. ..	0	9·67	385	2,097	1,712	0·170	0·271	0·584
	2	8·38	497	2,090	1,593	0·153	0·288	0·605
ST ..	4	6·84	686	2,079	1,393	0·134	0·307	0·625
	6	4·84	1,045	2,057	1,012	0·111	0·330	0·649
F.C. ..	8	0	2,000	2,000	0	0	0·441	0·750

It will be noticed that the curves of "A_0" and "needle diameter" (Fig 6) show a sudden change of slope towards the end of the stroke. This is due to allowance having been made

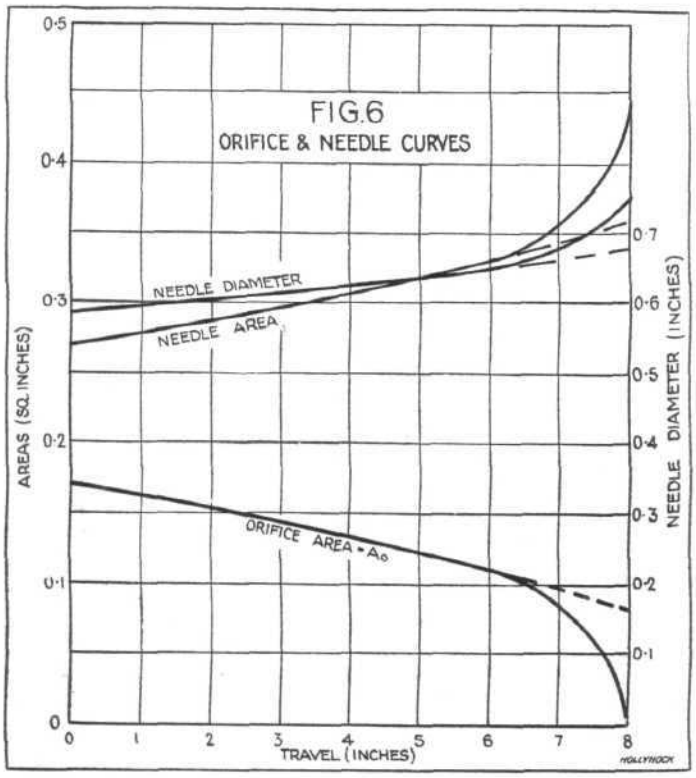


FIG.6
ORIFICE & NEEDLE CURVES

in the calculations for co-efficient of discharge, which must, of course, be eliminated towards the end. Also, the needle diameter at the end is given as $0 \cdot 75$ in., but in practice the orifice can never be zero or the leg would jam. So that a small orifice must be left and its dimensions will depend on the accuracy of workmanship obtainable, and the concentricity which may be expected to obtain between the needle and the piston under working conditions. In any case, a mechanical stop must be provided at the end of the stroke for safety.

Return Stroke.

If W = the external force acting on the oleo (*i.e.* such proportion of the undercarriage weight as comes on it),

p_{or} = Oil pressure during return stroke,
p_{ar} = Air " " "
A_{or} = Orifice area " "
A_{hr} = Orifice hole area during return stroke.

and A_g, A_e and A_h = Piston and orifice hole areas as before,
then $p_{or} \cdot A_e = W + P_{ar}A_h$

therefore, p_{or} being negative, $p_{or} = -\left(\dfrac{W + p_{or} \cdot A_h}{A_e}\right)$

and $p_{dr} = p_{ar} - p_{or} = p_{ar} + \dfrac{W + p_{ar}\,A_h}{A_e}$

$$= \frac{W}{A_e} + p_{ar}\left(1 + \frac{A_h}{A_e}\right) = 27 \cdot 4 + 1 \cdot 0604\, p_{ar}$$

The value of W will generally be approximately constant, but if it varies greatly, the calculations should be adjusted accordingly. For the purpose of this example, W will be taken as constant and equal to 200 lb.

If the hysteresis effect, due to mechanical friction and the inevitable slight loss of heat, is neglected, p_{ar} may be taken as equal to p_a and p_{dr} can easily be found for any position.

The velocity of return will be given (as for compression stroke) by the equation

$$A_{or} = 0 \cdot 731 \frac{V}{\sqrt{p_{dr}}}$$

and, if the area of the orifice is unchanged for the return stroke (*i.e.* if $A_{or} = A_o$), the velocity can be found directly.

In practice, however, it has been found desirable to decrease the return velocity in order to eliminate sloppiness and consequent risk of damage to wing tips. The actual maximum value is a matter of individual choice; but, for this example, will be taken as 4 ft. per sec.

To this end, the orifice must be restricted mechanically by some automatically functioning sliding valve or other suitable device. It is of the utmost importance, however, that whatever method is employed, there shall be no possibility of jamming in action.

Since the diameter of the needle is greatest at the commencement of the return stroke—it having been fixed for the compression stroke—it follows that even though an auxiliary valve is used for the return stroke, the orifice must increaes towards the finish. Therefore, the velocity will increase, so that it becomes necessary to make the auxiliary valve function on an extension of the needle for the last part of the stroke, in order to bring the velocity down to zero. (Care must be taken, however, to ensure that this does not in any way interfere with the action of the main valve during the compression stroke). Consequently, the velocity will increase until this stage is reached and then fall off comparatively rapidly—another reason why the maximum velocity should be limited; as, otherwise, the deceleration of the moving parts will be too rapid.

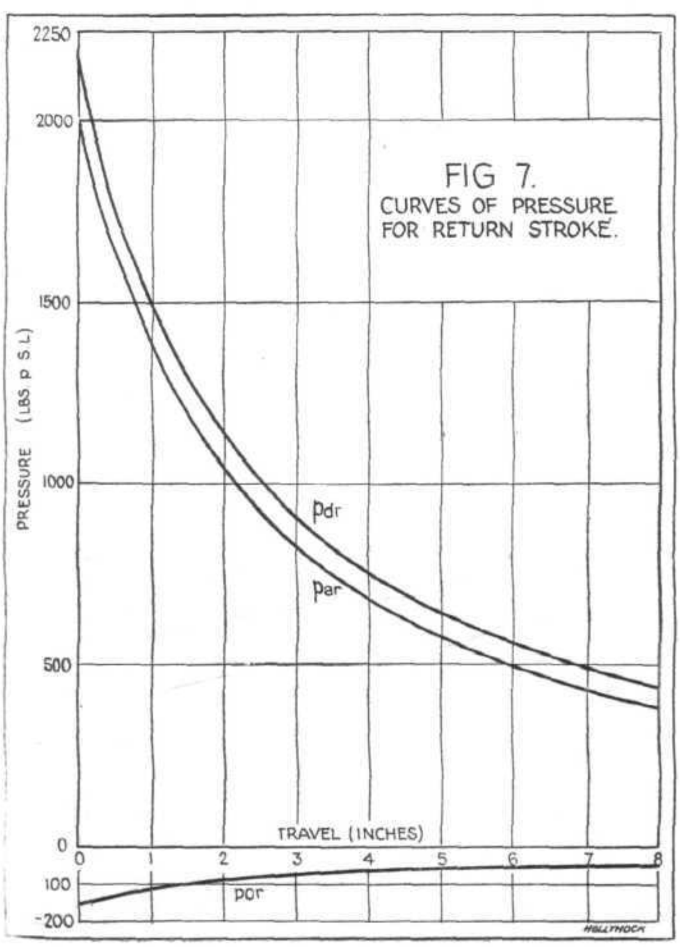


FIG 7. CURVES OF PRESSURE FOR RETURN STROKE.

If the change is made to occur at, say, 2 in. from the finish, then the velocity at that point is the maximum (viz. 4 ft. per sec.), and from the pressure curves (Fig. 7) p_{dr} is found to be 554 lb. per sq. in.

Therefore $A_{or} = 0 \cdot 731 \times \dfrac{4}{\sqrt{554}} = 0 \cdot 124$ sq. in.

and $A_{hr} = A_n + A_{or} = 0 \cdot 288 + 0 \cdot 124 = 0 \cdot 412$ sq. in.

Since A_{hr} is constant, at any point where the standard needle functions $A_{or} = A_{hr} - A_n$; so that A_{or} and V can be found for any position prior to that at which the needle extension comes into action. Beyond that point, the velocity and orifice must tail off to nothing—or as near nothing as practical considerations of manufacture will allow.

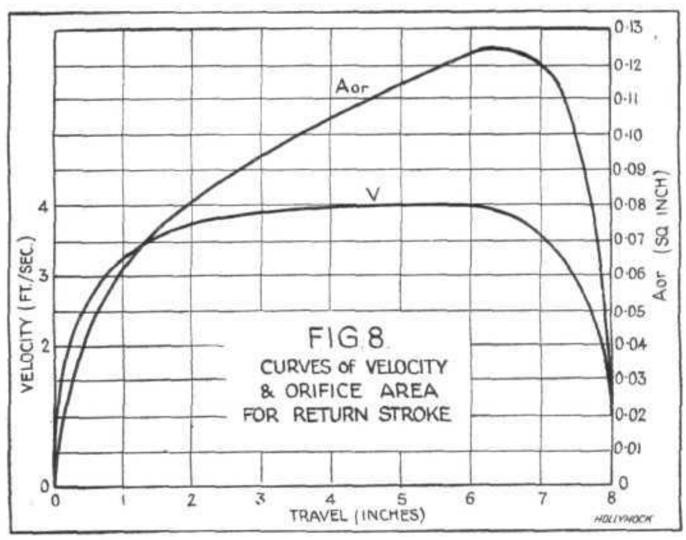


FIG 8. CURVES OF VELOCITY & ORIFICE AREA FOR RETURN STROKE

The values obtained should be tabulated as under and plotted for checking purposes as before (see **Figs. 7 and 8**).

Position.	Travel (inches).	p_{ar} lb. p.s.i.	p_{dr} lb. p.s.i.	p_{or} lb. p.s.i.	V ft./sec.	A_{or} sq. in.
F.C.	0	2,000	2,152	− 152	0	0
	2	1,045	1,137	− 92	3·79	0·082
ST.	4	686	755	− 69	3·95	0·105
	6	497	554	− 57	4·00	0·124
F.E.	8	385	435	− 50	0	0

In conclusion, it may be well to mention that the unit should be so designed that the oil level is well above the orifice (with a reasonable allowance for leakage) when inclined at the maximum angle which can obtain in service.

IN THE DRAWING OFFICE

SETTING OUT TAPER RIBS.

By R. Haley.

The application of shipbuilding formulæ to aircraft is fairly easy when dealing with floats and seaplanes; in fact, it is essential. But to apply any shipbuilding formula to wing construction requires a stretch of imagination. Nevertheless, the writer will endeavour to show how this *can* be applied in the case of taper ribs at wing tip.

FIG. I.

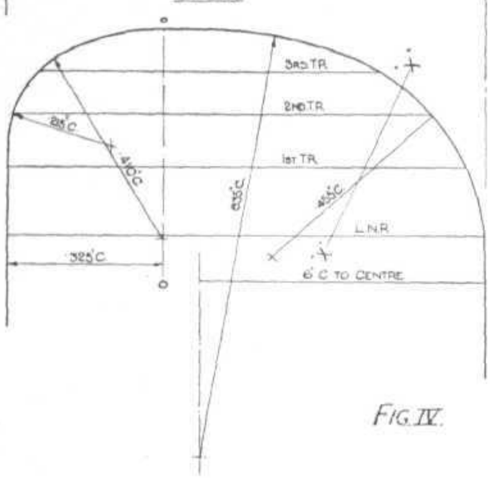
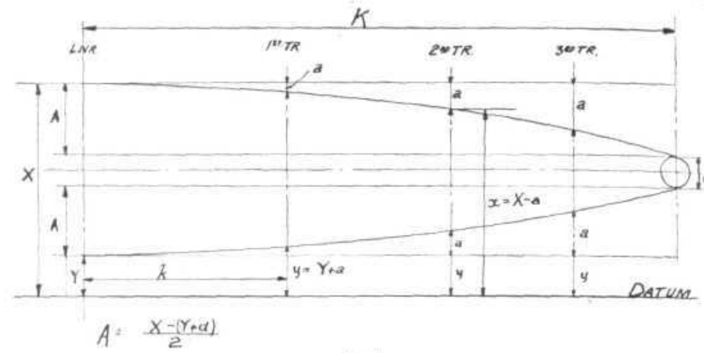


FIG. IV.



SECTION AT OO.

FIG. II.

RIB ORDINATES.

Distance from L.E.	X	Y	Y+d	X−Y+d	A	K	$\frac{K}{\sqrt{A}}$	k = 10" 1st Taper Rib a	x	y	k = 18" 2nd Taper Rib a	x	y	k = 24" 3rd Taper Rib a	x	y
·86	2·02	·51	1·26	·76	·38	20·2	32·3	·095	1·92	·605						
1·72	2·68	·28	1·03	1·65	·825	22·3	24·5	·166	2·51	·446						
3·45	3·43	·05	·82	2·61	1·30	25·3	22·2	·202	3·22	·252						
5·17	3·88	·0	·75	3·13	1·56	26·8	21·4	·218	3·66	·218						
6·9	4·17	·01	·76	3·41	1·70	28·0	21·5	·216	3·95	·226						

FIG. III.

R. Haley

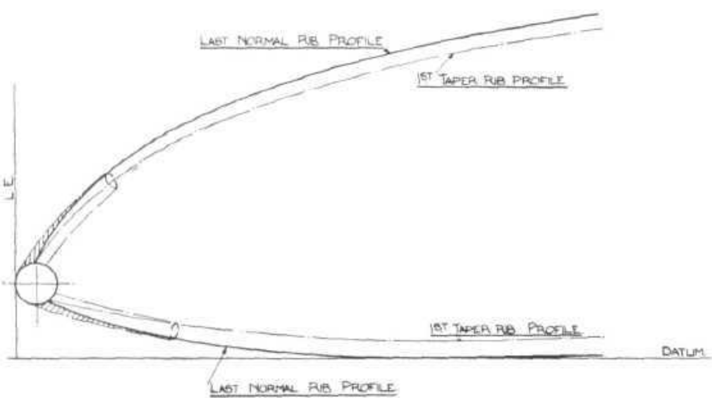


FIG. V.

The idea was taken from a treatise on yacht's lines, where the author of the treatise had based his assumption on the fact that a yacht's lines are of parabolic form, and he used the well-known formula for a parabola $a = \frac{Ak^2}{K^2}$. All the offsets for the lines were calculated and issued to the mould loft without a single lines drawing having been issued. The advantage gained is not the subject of this article.

In a "wash out" wing tip, the top and bottom surfaces usually conform to a parabola, and the formula $a = \frac{Ak^2}{K^2}$ could be altered to suit the working out of the ordinates for the taper ribs by expressing same thus:—

$$a = \left(\frac{k}{K/\sqrt{A}}\right)^2$$

The writer had occasion to require the true shape of a section of the wing tip at "XX," known as a "cant" in shipbuilding, and although the layout for the taper ribs was correct in profile, it was found on "lifting" the "cant," that the new shape was 0·1 inch out in height. This was, no doubt, due to the fact that the ribs were not faired in all three views.

As the new rib was in metal, it was necessary that this should be correct in profile, and by applying the formula already mentioned, it was possible to get the correct outline for the taper ribs, and hence the new rib at "XX," Fig. IV.

Fig. I. is a profile of the last normal rib marked L.N.R. in Fig. IV.

In the table of ordinates, Fig. III, the ordinates for the L.N.R. are marked X and Y, being top and bottom ordinates respectively, above datum. Let d equal the diameter of the wing tip tube, K the distance of L.N.R. from wing tip tube, centre to centre, $A = \frac{X - (Y + d)}{2}$, Fig. II, and k the distance from L.N.R. to taper ribs, 1, 2 and 3.

x and y are top and bottom ordinates of taper ribs above datum, see Fig. II. $x = X - a$ and $y = Y + a$.

In the example marked in Fig. III, d was taken at 0·75 inch diameter.

In the eighth column from the left we get $\frac{K}{\sqrt{A}}$, and this remains constant throughout the rest of the working, the only variable being k. Values of a can easily be worked on the slide-rule, watching the decimal point in doing so.

There may be two or three taper nose ribs between each full taper rib and a column for these can be inserted in the correct place, if necessary.

In Fig. V, the nose of L.N.R. and the first taper rib have been laid out from the tables in Fig. III, from the L.E. to the front spar only, and the rib flange centre is shown running into the centre of the L.E. tube, the hatched portion showing the fabric leaving the rib to pass over the L.E. tube. The top and bottom flanges of the rib can, of course, be run in tangential to the L.E. tube, and is a matter of choice of attachment of ribs to L.E. tube. In laying out the wing tip in plan, the writer has shown radii in terms of "C," the chord, trusting same will be useful to junior draughtsmen when laying out a round wing tip. The form obtained will be found to give good results aerodynamically.

All ordinates are above datum, and the datum in Fig. II has been purposely shown much lower than is found in practice to show up a and y more clearly, but is truly represented in Fig. I.

Owing to lack of space, the summaries of Aeronautical Research Committee Reports and Memoranda which usually appear in the last part of THE AIRCRAFT ENGINEER *have had to be held over this month. It is hoped to publish a lengthy series of them in the May issue.*—ED.

AIR TRANSPORT

THE FOKKER F. 32

A four-engined commercial monoplane produced to meet the demand for a machine carrying thirty passengers on busy air routes. Such a demand was felt in America, existing 8-16 passenger machines being unable to cope with increased traffic, and as a result, the Fokker Aircraft Corporation of America produced the F. 32 described below

BRIEF reference was made in FLIGHT a short while ago to the Fokker F.32 four-engine monoplane, which is employed on certain air lines in America, and which will probably be used on the Dutch East Indies service. This week we are able to give a description of this machine from information supplied by the Fokker Co., of Amsterdam.

As with the majority of Fokker commercial machines, the F.32 is a cantilever monoplane, and has four engines—575 h.p. Pratt & Whitney "Hornet B"—mounted tandemwise in pairs under the wings on each side of the fuselage.

The wing consists of 2 box spars with section-shaped ribs slid on to them. These spars measure 43—31/32 in. (1.10 m.) front and 34—33/64 in. (0.87 m.) deep at the centre. The leading edge has a sweep back of 56 in. (1.42 m.), and the under surface has a negative dihedral of 3½°. The leading edge of the centre section is cut away, and the roof of the cockpit made flush with the wing's upper surface. The wing is covered with plywood.

The wing is secured by means of four bolts, to joints in the framework of the fuselage. Four fuel tanks are installed between the spars, two on either side of the fuselage.

As is customary in Fokker aircraft, the fuselage is made up of a framework of seamless cold drawn steel tubes autogenously welded together and braced by means of steel wire and tubular diagonals. Under the cabin the framework is further stiffened by corrugated dural, on which the plywood floor (3/16 in.) is laid. A fuselage tail piece is used to fair the end of the fuselage and made detachable in order to facilitate inspecting of the interior of the fuselage.

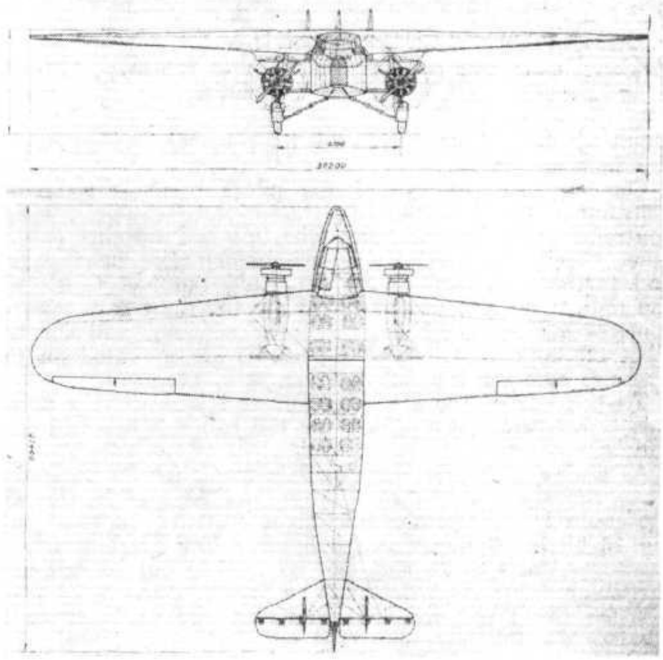
In the nose of the machine is the luggage hold, which extends under the cockpit and has a cubic capacity of 120 cu. ft. (3.4 m.³). The walls of this compartment are lined to a height of 30 in. (75 cm.) with sheet aluminium. Two windows, 8½ in. (22 cm.) in diameter, located one on either side, furnish the daylight.

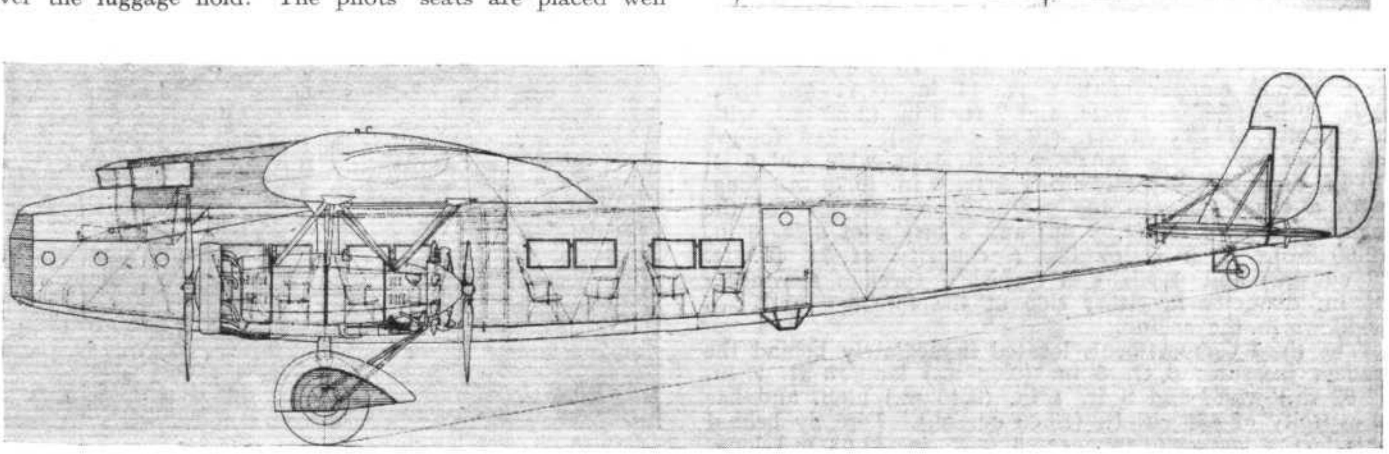
A trap-door, 27 in. (69 cm.) wide by 40—5/16 in. long (1.03 cm.), in the lower wall gives access to the cockpit and luggage hold. When open this door extends into a ladder, having ten steps from the ground to the cockpit.

The amount of space available for radio installation is 3.4 in. (1.20 m.) long, 3.9 in. (1.14 m.) high, and 7 ft. (2.13 m.) wide, extending under the cockpit from one side of the plane to the other. On either side there is a round window 8½ in. (22 cm.) in diameter.

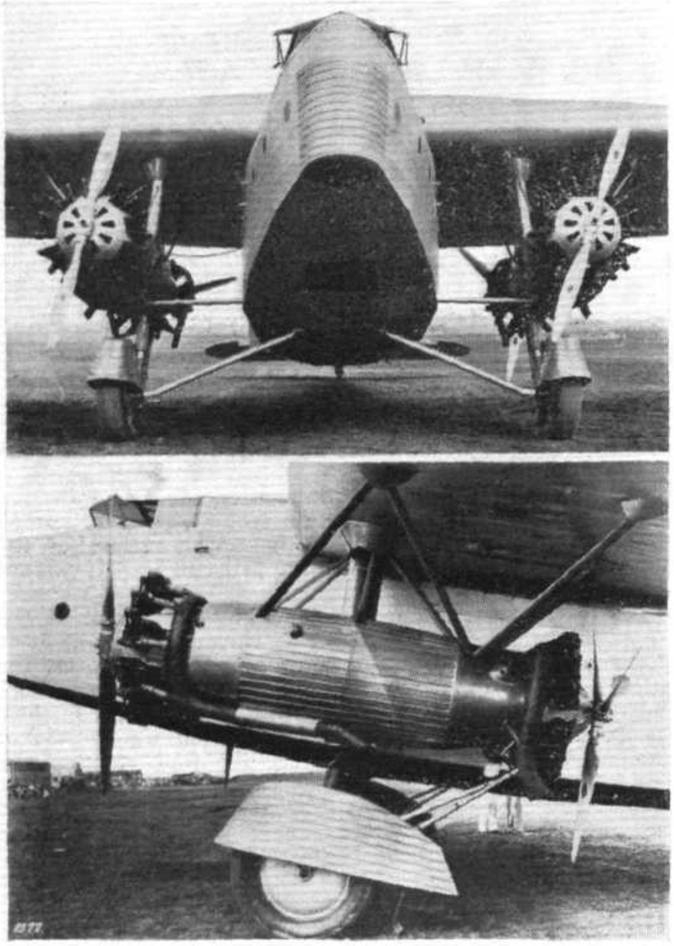
The cockpit is immediately to the rear of and partly over the luggage hold. The pilots' seats are placed well forward, and the window has an inwardly slanted V front of 110° included angle. Each section of the V contains a sliding window, while the windows in the side walls are also made sliding. The top of the cockpit, made of domed sheet aluminium, is flush with the upper surface of the wing. Green celluloid windows are fitted in the aluminium roofing for upward visibility.

The instruments are mounted within easy reach of the pilots. On the left of the main instrument board, in front of the pilots, are the compass, the air-speed indicator, the altimeter, rate of climb indicator, the gyroscopic bank and turn indicator, a transversal inclinometer, and, further, the switches for the navigation lights. In the middle of the board are the tachometers for the four engines, the four throttle levers (the centre two operating the rear engines and the outer ones the front engine throttles) and the master cutout switch. The independent ignition switches are mounted on a board under the throttle levers. On the right-hand side of the main instrument board are





Plan, front and side views of the Fokker F.32.



Front and side views of the engine installation of the Fokker F.32. The engines are Pratt & Whitney, 575-h.p. "Hornet B" radials.

mounted the oil pressure and temperature indicators for the four engines.

Centrally located behind the pilots there is a second instrument board containing the mixture controls, spark controls, starter switches and vibrating coil switches (which take the place of starter magnetos) (see next page), and further the handles for operating the fuel taps. On the right-hand side of this board are the right flare release, controls for the right engine's nose cowling, and for the right oil tank vent. Similar controls are mounted on the opposite side for the left-hand engines, etc.

To the left of the second pilot, and immediately under this board, are the switches for the cabin lights and fuse panels.

As a day transport, provision is made for 30 passenger seats, arranged in four compartments. As a night sleeper, the cabin is transformed into eight sections, accommodating 16 births, 8 upper and 8 lower. Any combination of passenger, mail and goods can be worked out to suit any particular commercial demands or private owner.

When fitted out for 30 passengers, the cabin space is divided as follows:—Forward compartment, directly behind pilot's cockpit, 6 ft. 0½ in. (1.84 m.) long, 7 ft. 7 in. (2.31 m.) wide, and 5 ft. 9 in. (1.75 m.) high, having a capacity of 263 cu. ft. (7.44 cu. m.). To the rear of this is a second compartment, 6 ft. 11 in. (2.11 m.) long, 8 ft. 10 in. (2.69 m.) wide, and 7 ft. 5 in. (2.26 m.), with a capacity of 453 cu. ft. (12.83 cu. m.). Then follows on either side of the gangway (2 ft. 1 in. wide and 5 ft. 10 in. high) a galley measuring 2 ft. 6 in. (0.76 m.) long, with a space between the gangway and the side of the plane of 3 ft. 4 in. (1.02 m.) and a height of 8 ft. 6 in. (2.59 m.). Each galley has a capacity of 71 cu. ft. (2 cu. m.) and daylight is furnished through a window 8½ in. diameter in either side of the fuselage, and two windows in the ceiling.

The third compartment, located immediately behind the galley, measures 6 ft. 8 in. (2.03 m.) long, 8 ft. 7 in. (2.62 m.) wide, and 8 ft. 1 in. (2.46 m.) high, and has a capacity of 460 cu. ft. (13.03 cu. m.). Directly behind this is the last compartment, 6 ft. 8 in. (2.03 m.) long, 8 ft. 3 in. (2.51 m.) wide and 7 ft. 8½ in. (2.35 m.) high; capacity, 423 cu. ft. (11.97 cu. m.). The total space available for passengers is therefore 1,598 cu. ft. (45.27 cu. m.).

Behind the last compartment, and running across the plane, is the entrance compartment, 2 ft. 6 in. (0.76 m.) long, 8 ft. 2 in. (2.49 m.) wide, and 6 ft. 11 in. (2.12 m.) high. There are two aluminium frame doors, one on each side, 2 ft. 6 in. wide and 4 ft. 9 in. high, each having an 8-in. diameter window. Behind this entrance passage are two lavatories, 2 ft. 10 in. long, 3 ft. 9½ in. wide, and 6 ft. 6½ in. high.

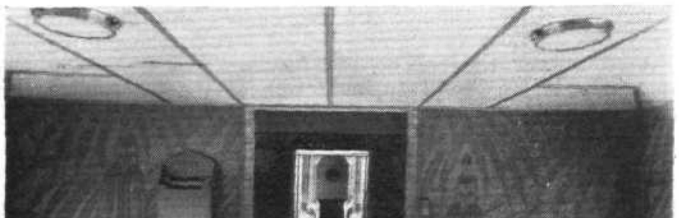
The cabin has 16 windows, 26 in. × 16 in., of 3/16 in. non-shatterable glass. Good ventilation is provided by means of 18 "S" type ventilators, each having a throat diameter of ⅞ in. These are so arranged that, by turning them, either suction of cabin air or pressure of outside air into the cabin can be regulated. Twelve dome lamps provide the lighting for the cabin.

The nose tip of the fuselage, the upper surface up to the cockpit, the roof and sides of the cockpit as far as the wing, and the engine beds, are all covered with sheet aluminium. The remainder of the fuselage has a covering of fabric.

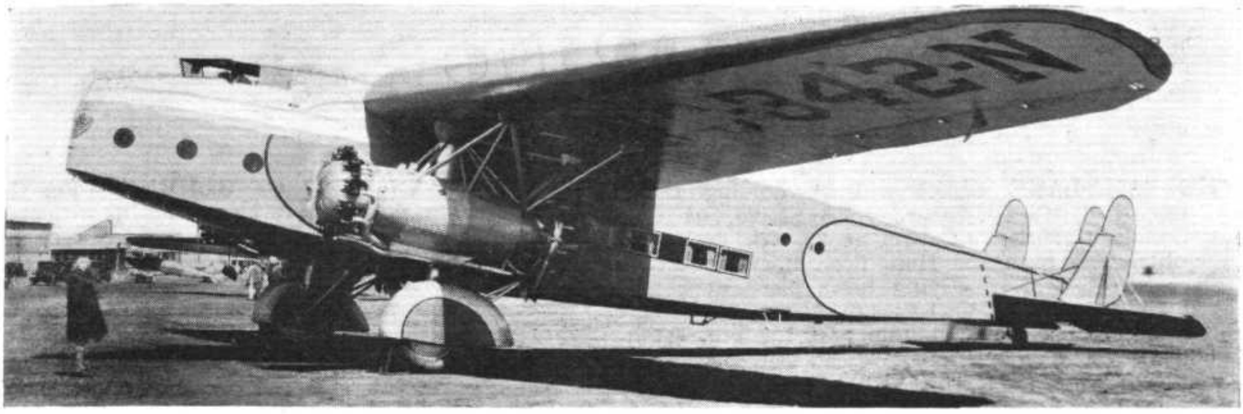
The ailerons are of wood, and are unbalanced, while the tail planes are made up of welded steel tubes, fabric covered; the elevators and rudders are balanced, and the stabiliser may be adjusted during flight. Dual controls are fitted, consisting of a central steering column with a wheel mounted on either side for operating the ailerons. The rudders are operated by means of pedals, while the brakes are operated by means of a lever on the left of the first pilot.

The under-carriage is made in two halves, each consisting of a steel axle, with bracing struts running from the axle at the wheel, to the engine bed just ahead of the rear engine. Ball and socket connections are used to secure struts to the engine bed and axles to the fuselage. The vertical shock-absorber strut consists of a Gruss cylinder (oleo-pneumatic) and is connected at one end to the brake flange and at the other to the engine bed. In order to reduce resistance the wheels have a streamline cowling.

The tail wheel is mounted in a fork which turns on ball bearings. The normal rotation of the wheel is 30°, but should a sudden side load demand greater rotation an auto-



A view of the cabin (top) and pilot's cockpit in the Fokker F.32.



The Fokker F.32, four-engined 30-seater cabin monoplane.

matic release comes into action and permits complete wheel rotation. In addition a hand release is also provided for moving the machine round by ground staff. The track of the undercarriage is 20 ft. (6.10 m.); Bendix wheels, 54 in. × 12 in., are fitted with Bendix brakes, and Timken roller bearings.

The 4 Pratt & Whitney "Hornet B" engines of 575 h.p. each are mounted in pairs tandem-wise under the wing to the right and left of the fuselage. Each pair of engines is installed in a bed of welded steel tubes, secured to the front and rear wing spars.

The front engines rotate anti-clockwise and the rear engines clockwise. The front airscrews are of the Standard Steel two-bladed tractor type, while three-bladed pusher propellers are used on the rear engines.

Each of the engines has an electric inertia starter. Instead of the customary booster magnetos, vibrating coils are used. A two-way primer cock and pump is installed for each pair of engines. Engine-driven generators are mounted on the two foremost engines.

Each engine exhaust manifold is oval in section to reduce area resistance. The front exhaust manifolds have a single outlet, the rear exhaust manifolds two, one on each side and deflected outward to obtain better diffusion of the exhaust gas in the slip stream. The engine beds are cowled at the sides with fixed panels of corrugated dural, while the engine cowls front and rear are plain sheets merely secured with safety-pins to facilitate engine inspection and servicing.

The heating installation of the cabin is connected up with the front exhaust manifold. The warm air is conducted through two streamline pipes running horizontally between the engine beds and the fuselage to the cabin.

Four fuel tanks are installed between the wing spars; two on either side of the fuselage. Each tank has a capacity of 175 U.S. gallons (662.4 litres), so that the total fuel supply amounts to 700 U.S. gallons (approximately 2,650 litres). The tanks are made of welded sheet aluminium. The fuel system connections are so arranged that the two tanks on either side can feed either front or rear engine, or both, from either one or two tanks. All fuel conduits are outside the fuselage.

A double oil tank is located between the engines in each bed. The tanks are made of welded sheet aluminium, and each tank section has a capacity of 15 U.S. gallons (approximately 57 litres). At the bottom of each tank are nine 1-in. diameter tubes, connecting up with a wide pipe which projects inside the engine bed. The wide pipe takes the air from the front propeller slipstream, blows it through the tubes and exhausts it within the engine-bed cowling. This arrangement provides adequate cooling for the oil supply.

The principal characteristics of the Fokker F.32 are:—Span, 99 ft.; length, 69 ft.; height, 16 ft. 6 in.; wing area, 1,330 sq. ft.; weight, empty, 14,910 lb.; useful load, 9,340 lb.; total weight, 24,250 lb.; wing loading, 18.23 lb./sq. ft.; power loading, 10.6 lb./h.p.; speed range, 63-146.6 m.p.h.; cruising speed, 123 m.p.h.; climb at sea level, 850 ft./min.; service ceiling, 13,000 ft.; range at cruising speed, 770 miles.

DEVELOPMENTS IN TASMANIA

THE formation of a Tasmanian branch of the Australian Aero Club and the opening of an aerodrome near Launceston, which is the headquarters of the club, has encouraged a considerable amount of flying in the State. This interest was still further increased when Australian National Airways initiated a transport service across the Straits.

So far there is only one authorised and licensed aerodrome in Tasmania, which was purchased and put in order by the civil aviation branch of the Defence department. These developments have led to the creation of more interest in flying in the southern parts of the State, and this has been helped by the committee of the Aero Club, which recognises that the possession of only one aerodrome must limit very much the extension of flying, both as a joyous pastime and for commercial purposes.

A meeting called by the mayor in consequence of a requisition by ratepayers was held in Hobart on February 20. It was a thoroughly representative gathering, with Ministers present. The business community was very strongly represented, and a delegation came from Launceston, including the president and several committeemen of the Aero Club.

Amongst those who attended were Mr. Ulm, managing director of Australian National Airways, and also representatives of the Matthew's Aviation Company. A committee was formed to consider sites and to make, through the Premier, such representations as may eventually lead the Defence department to purchase a ground within a reasonable distance of the city. It was recognised that the department at present has no money, but in all probability arrangements will be made to obtain use of suitable ground, have it licensed, and hold it until the department is able to find the necessary money.

The Hobart correspondent of *The Times* states that the success of the air service carried on between Melbourne and northern Tasmania by Australian National Airways, Limited—to which we referred in our issue of April 3 last—led Flight-Lieut. C. T. P. Ulm, managing director, to inform the Council of the Hobart Chamber of Commerce on February 17 that a tri-weekly service between Melbourne and Hobart would be instituted very shortly, and that in the near future his company would operate a daily service, calling at Western Junction, the northern aerodrome, *en route*.

Excepting the experimental air mail service now being carried out by Imperial Airways, at present there is only a short link between Australia and Sourabaya not connected with the air service to England and Europe. In normal times, Flight-Lieut. Ulm pointed out, that link would have been connected. He predicted that by the end of next year Tasmanian letters would be delivered in London in 15 or 16 days. When that time arrived Hobart would be in the position of the extreme Imperial air outpost.

GLIDING

THE SAILPLANE CLUB will be holding their second dance on Saturday, April 25, at the Suffolk Galleries. Tickets at 2*s*. 6*d*. each are obtainable from the Hon. Sec., 2, Wine Office Court, Fleet Street, E.C.4. Flying takes place at Small Dole every Sunday, when visitors are always welcome. Those proposing to come should note that the best route from London is via Horsham and Henfield and thence on to the Shoreham road. Their last dance was an astonishingly successful affair, and it is due to this fact that this second one is being held. All members and others are asked to do their best to maintain this standard of excellence and to make a point of coming so that the dance will be even more successful than the previous one, and also so that the club funds will be augmented in a way which is pleasurable to the members.

THE SKYSAILING CLUB are having meetings every Sunday at Mr. Nixon's Barn on Ditchling Beacon. After having tried several grounds in the vicinity during the last few months, they are satisfied that this ridge is the most satisfactory one upon which they can settle permanently.

GLIDING IN ESSEX:—The South Essex Aero Club are doing a lot of gliding every Saturday and Sunday on Langdon Hills, Essex, and a cordial invitation is extended to all visitors who are interested. Particulars as to membership of the club will be furnished on request by the Hon. Sec., 41, Hall Road, Chadwell Heath, Essex.

THE KENT GLIDING CLUB held the first of a series of auto-towed gliding demonstrations at Gillingham on Sunday, April 12. Mr. Lowe Wylde, of B.A.C., Ltd., was making this demonstration with one of his B.A.C. two-seater sailplanes. The weather was perfect, and Mr. Wylde took up a large number of the club members.

THE GERMAN VIEW OF GLIDING:—For those who are fortunate enough to be conversant with the German language, there has recently been issued a very interesting booklet entitled "Das Segelflugzeug," which has been written by Dr. Ing. W. v. Langsdorff. This carries the reader through the development and construction of all types of gliders, the construction being divided into the various component parts, and is profusely illustrated with a separate section of photographs showing very clearly current German practice for all types. This little book can be obtained from J. F. Lehmanns Verlag München, the price being 10 marks.

GLIDING AT BRADFORD:—One of two sites will be used on May 2 and 3 by Herr Magersuppe for a soaring demonstration. The first is at Amblerthorne, near Queensbury, and the second at Woodhorne Hills, near Thornebury. Herr Magersuppe will be bringing a two-seater sailplane so that if conditions are suitable passengers may be carried.

ILKLEY GLIDING CLUB:—The Ilkley club have secured a very fine site on a five years' lease, to the north-west of Malham, among the hills near Malham Tarn. This is in the form of a large basin, and it is possible for gliding to be carried on no matter from what direction the wind may be blowing. Slopes vary from gentle gradients, upon which primary training may be carried out to large heights suitable for advanced soaring.

THE AMERICAN POINT OF VIEW:—Published by the Soaring Flight Co., 16, Hunter Avenue, Clarendon, Virginia, U.S.A., "Sailplaning" is an interesting little book which explains the dynamics of soaring flight and velocities and forces entailed. The language used cannot be said to be particularly clear or easy to follow for those who have no knowledge of the subject at all, but for those who have already had some little training in aeronautics it should be fairly easy.

AIR TRAVEL IN CHINA

WE are indebted to Shell-Mex Ltd. for the following details of a memorandum issued by the Chinese National Government at Nanking in respect to the formalities required of aviators wishing to obtain permission to fly over Chinese territory, which we think may be of interest to our readers—especially those who anticipate making a week-end flip to the land of the Willow Pattern!

Provisional Scheme Granting Special Permission for Foreign Aeroplanes to Fly Over Chinese Territory.

1. When foreign aeroplanes come to China, formal notice should be given in advance by the foreign Minister or the local Consul; they may only enter Chinese territory after special permission from the Chinese Government.

2. The foreign Minister or the Consul shall make a declaration to the effect that these aeroplanes are not for military use and will not be used for other purposes. They shall be liable to examination by the officers appointed by the Chinese Government at the various places of landing or taking off.

3. The foreign Minister or the Consul shall furnish information on the following points:—

(*a*) Object of the flight.
(*b*) Places of entering and leaving Chinese territory.
(*c*) Place of arrival and route to be followed.
(*d*) Starting point and route to China, and dates of stay in Chinese territory.
(*e*) Number and names of aviators or other persons employed in connection with the flight.
(*f*) Number and description of aeroplanes, marks, descriptions of engines and horse-power.

4. The foreign Minister or Consul shall furnish a statement of the route to be followed by the foreign aeroplanes in flying over Chinese territory, and this shall, upon receiving the sanction of the Chinese Government, be definitely fixed upon. These aeroplanes must follow the route fixed, they may not fly to other places, and they may not freely land and restart outside the designated areas. The width of the route zone shall be 20 kilometres.

5. Foreign aeroplanes which come to China and follow the route prescribed by China shall not be allowed to fly within a 5-kilometre radius of places where flying is prohibited. The places in question where flying shall be prohibited will be designated as soon as the various provinces have investigated and reported. Pending such designation temporary arrangements will be made in the event of foreign aeroplanes coming to China.

6. Should it be necessary for foreign aeroplanes coming to China to land in Chinese territory, the foreign Minister or Consul shall inform the Chinese Government, who will assign the locality.

7. The aeroplanes shall carry no articles of contraband, photographic apparatus, wireless apparatus, postal matter, nor merchandise.

The aeroplane shall not fly at such a low altitude over thickly populated places lying on the route as to endanger the lives and property of the public, nor shall any objects be dropped from the air.

8. The foreign aeroplanes shall, when flying over Chinese territory, carry all necessary flying certificates, &c., as well as log-books, in order to facilitate inspection. They shall conform to all regulations applying to aviation.

9. The above is a special temporary scheme for granting permission, and has no connection with the International Aviation Convention, which has not yet been ratified by China.

AIRPORT NEWS

CROYDON WEEKLY NOTES

APRIL has done its best to uphold its traditions during the last week, and has managed to drag in March as well, but, fortunately, the services have not been affected to any great extent. Saturday was the worst day, and many of the early services were delayed some hours owing to low clouds. Improvement set in about mid-day, and services were enabled to run normally for the rest of the day, which, incidentally, was the last day of the winter schedule.

Last Monday a German-owned Puss Moth arrived from Dresden. It was the property of Haus Bergman, cigarette makers of Dresden, and the fact was displayed all over the machine. On the sides of the fuselage was the owner's name in red, and across the underside of the wings, in black, was the brand of cigarettes made. The international appeal of Moths and Puss Moths has been much in evidence here lately, German, French, Swiss and Austrian owners all passing through within the last fortnight.

On Tuesday Personal Flying Services Sikorsky left here on a rush job to Jersey with a talkie film, "Sweethearts and Wives." This film had to be on the screen by 6 p.m., and although late when it left Croydon, reached Jersey with an hour to spare. The landing was made in St. Helier's Bay, the Sikorsky being an amphibian.

Wednesday was the day of many specials. The course of events in Spain caused Fleet Street to sit up and take notice, and specials were at a premium, night and day.

On Saturday great interest was aroused by the arrival from Brussels of Capt. Hawks, of the Texas Oil Co. of America, with a Travel Air machine. It is a very long time since we saw a machine with such a turn of speed. She is reputed to be able to cruise at 200 m.p.h., with a top speed of 240 m.p.h. I can well believe this, judging by the way it approached the aerodrome and the time of the journey. A strong gale was blowing against him, and the service machines were taking three hours for the trip, but this machine did the journey in 1 hour 20 minutes. Had the wind been favourable it seems that the journey could have been made in under an hour. Quite a large crowd assembled to meet Capt. Hawks. He must be a man who believes in defying superstition, as his machine is named the Texaco 13, and its national registration marks NR1313. Capt. Hawks has promised to give a few demonstrations with the machine before he leaves, and everyone is anxious to see what it really can do. He left later for Hanworth, but is expected back in a few days.

Another new Redwing has made its appearance, and the name of the firm has been changed from Robinson Aircraft Co. to Redwing Aircraft Co. This is their third machine since the company was formed, and I believe they are about to start production in earnest.

Another Puss Moth of Wilson Air Lines of Kenya paid us a visit during the week; they are becoming quite frequent visitors lately.

One of the flight engineers of the Royal Dutch Air Lines has just taken his "A" licence with the Henderson Aviation Bureau. He has learned to fly in his spare time at Croydon. Arriving from Holland in the mornings, he has taken instruction at every opportunity before going out on his service again.

The following appeared in a London evening paper: "While Mr. Oscar Dawson, an airman, was making a flight at Raleigh, North Carolina, a large section of wing fabric tore loose from his plane. He was able to land safely. Mechanics ripped the wing open and found a mouse huddled in a nest of threads gnawed from the fabric." It wants Capt. Grace and his A.I.D. staff around there.

It is to be hoped that Mr. Hunt, late of Imperial Airways, who was injured in the crash of the Ford monoplane, belonging to Prince Bibesco, in Bengal, will soon recover. It is understood that this crash was caused by a collision with a vulture, which damaged the port propeller.

Summer time is here again, and with it summer services, but the muddy state of the aerodrome reminds me of November at its worst. The traffic figures for the week:—Passengers, 781; freight, 43 tons.

B.P.

A New Southern Airport

It is reported that the Town Council of Brighton in committee on Friday, April 17, accepted proposals for the establishment of a Municipal Aerodrome at Shoreham. This town is to be associated with those of Hove and Worthing in establishing this municipal aerodrome on the site of the old aerodrome of Lees' Barn, near Shoreham-by-Sea, and each authority is to provide £16,000 capital. This ground has been used as an aerodrome at intervals since the very earliest days, and when finished with hangars, a large clubhouse, restaurant and other facilities it should form one of the most attractive ports of call for flying people in the south of England. Its situation is unique in the facilities it provides, for on both the north and south ends there are main roads along which frequent bus services run from Worthing to Brighton, also the southern end is bound by the railway with a station actually on the aerodrome. On the western side is a communication road and on the eastern side is the river. No one, therefore, will ever be able to say that the new Shoreham airport has that glaring disadvantage of so many other similar aerodromes, in that it is inaccessible. It is also particularly good for the purpose, in the matter of weather, and time and time again it is possible to fly there and to arrive there from the north via the Lancing Gap in the Downs when the whole of the surrounding country is wrapped in low cloud, in fact the number of days when even Brighton and Worthing are not fit for flying but when it is possible to do so at Shoreham is very large indeed. Serving as it will do three municipalities, each of whom caters for a vast number of transient visitors, it should provide a very remunerative addition to the range of attractions already found at these places, and if properly run we can visualise it as a popular port of call for all those taking their holidays down there whether they be of long or short duration.

New Customs Aerodrome for Ireland?

A report appeared in the columns of the "Wexford People" recently regarding the use of the grounds of Johnstown Castle as an aerodrome with Customs facilities. We now learn that this may become an accomplished fact within the next few weeks. Johnstown Castle is a few miles from the city of Wexford, and if the necessary Customs arrangements were made it would mean a great saving of time for pilots wishing to fly direct to the south and south-west of Ireland, at present they are required to make their landing for Customs examination at Baldonnell, about eighty miles north of Wexford; the sea-crossing via Fishguard-Rosslare is shorter by about ten miles than the Holyhead-Dublin route. We must now wait and pray that this is not another of the "mare's nests" of Irish flying.

Moscow Airport

A large airport for civil aviation, now under construction at Moscow, is expected to be completed this summer. The authorities claim that the port will be one of the most efficient in the world, and it will have special equipment for night landings. Seven lines will be served by the port, including those from Moscow to Kharkov, Moscow to Tiflis, Moscow to Novosibirsk, and Moscow to Leningrad as well as the German Berlin-Moscow line.

Windhoek (S. Africa) Aerodrome

At a recent meeting of the Town Council it was decided to spend over £2,500 on the Windhoek aerodrome. Representations have been made by the South-West Africa Airways for an extension of the ground and also for hangars and offices. The Council decided to build hangars and offices at the aerodrome complete with all modern conveniences. The ground, too, is to be extended, and when the works are completed the aerodrome will measure 1,000 yards by 1,700 yards, and will therefore be entitled to a full licence as an aerodrome. The expenditure will be met out of loan funds, and not out of current revenue.

AIRISMS FROM THE FOUR WINDS

The R.A.F. Flight to Basra

It is now stated that the delay on the flight of the three "Rangoon" flying boats of No. 209 F.B. Squadron was due to a contretemps at Malta. When the boats were taking off there in pretty rough water, one of the hulls buckled. On examination it was found desirable to strengthen the hulls of all three boats, and mechanics were sent out from Rochester to carry out the work. The squadron took off again from Malta at 4.47 a.m. on April 16, and reached Lollum at 11.50 a.m. On the 17th it flew to Aboukir; on the 18th to Alexandretta; and on the 18th they alighted at Lake Habbanizah, about 55 miles west of Baghdad.

Prizes for Trans-Pacific Flight

A prize of 100,000 yen (£10,000) to the first Japanese who makes a direct flight across the Pacific, and one of 50,000 yen (£5,000) to the first foreign pilot to do so, has been offered by the *Asahi*—the enterprising Japanese newspaper, which has for some time taken an active interest in commercial aviation and operates its own fleet of aeroplanes. Any type of machine may be used, and the flight may be from east to west or from west to east. Refuelling in the air is permitted. The crossing must be made between the main island of Japan and some point on the Pacific Coast of the North American continent. The offer remains open for one year.

Capt. Matthews' New Venture

An attack on the Karachi-London air record of five and a half days is to be made by Capt. F. R. Matthews, who made a solo flight to Australia in a Gipsy Moth last autumn.

To Challenge Scott's Record

It is reported from Melbourne that Guy Menzies, who recently made a flight across the Tasman Sea in the *Southern Cross Junior* (which was wrecked on April 12), is coming to England to procure an Avian Sports of the same type as the *Southern Cross Junior* to attack Scott's record. He hopes to make the trip from England to Australia in seven days, compared with Scott's time of 9 days 4 hours.

Prince Bibesco Crashes

Prince Bibesco, who started from Le Bourget in his Ford Pullman on April 9 for the Far East, has come to grief. The Prince and his three companions—two Roumanian air officers, Maj. Burduloin and Capt. Beller, and Mr. P. A. Hunt, an English mechanic of the Ford Co.—had left Karachi on April 16 for Jodhpur. Next day, just before reaching Allahabad, they ran into a vulture, which caused slight damage to an engine cowling. They landed safely at Allahabad, and, after refuelling, left for Calcutta. According to reports, shortly after they ran into another vulture, which so damaged the machine that a forced landing had to be made in a field between Moghal Serai and Gaya. In landing, the machine crashed and caught fire, but the occupants managed to escape, although injured. They were later conveyed to hospital at Benares; Capt. Beller died from his injuries on April 20, but the Prince and the other two are progressing favourably.

Sir John Salmond Returns

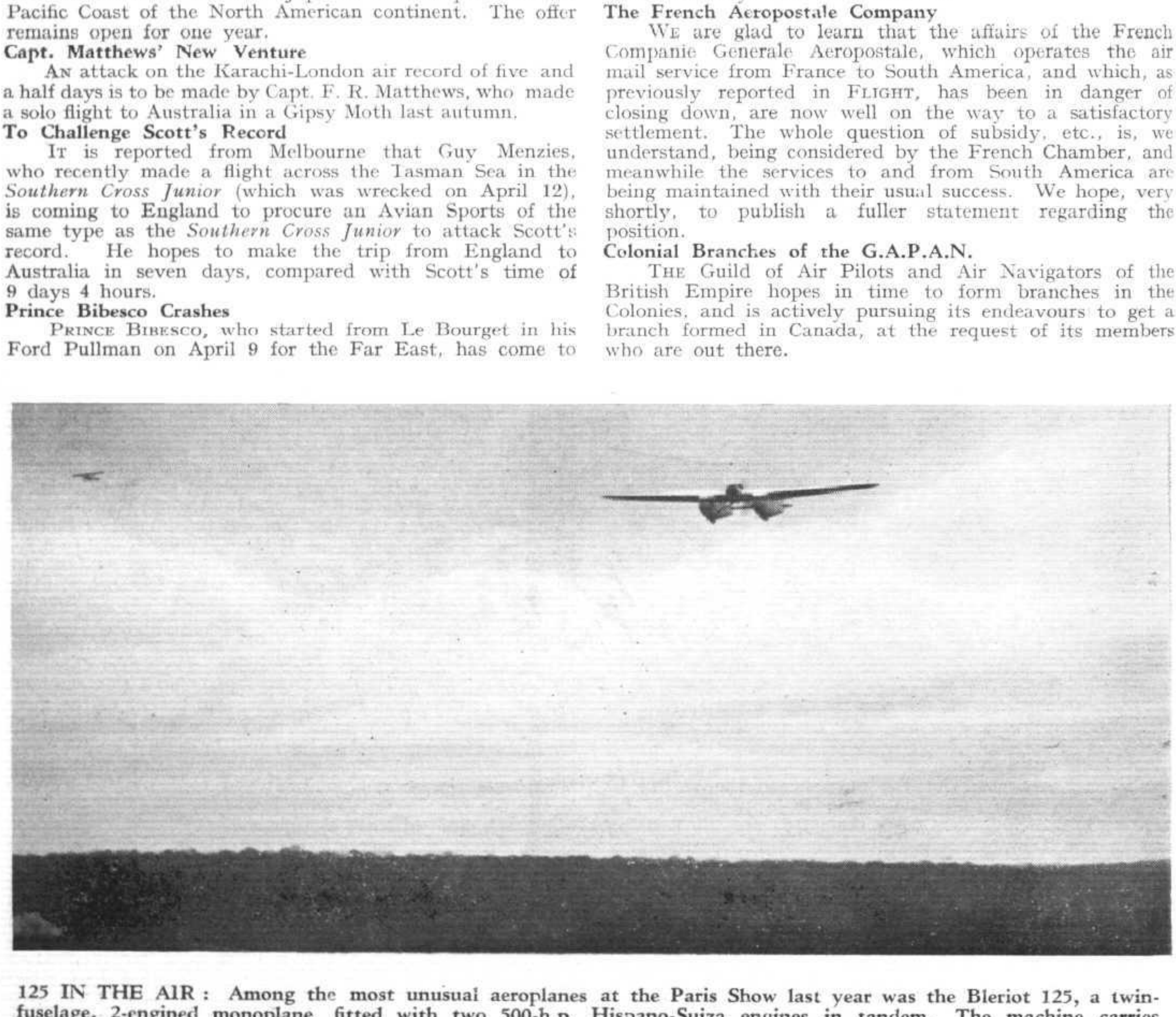
Air Chief Marshal Sir John Salmond, Chief of Air Staff, has concluded his tour of inspection of R.A.F. stations in Malta, Egypt, Palestine and Transjordan. He arrived by air at Berre, Marseilles, from Naples, on April 13, whence he proceeded overland to London. Sir John, it will be remembered, made part of the outward journey in one of the Iris flying boats of No. 209 Sq. which left Plymouth on March 24.

The French Aeropostale Company

We are glad to learn that the affairs of the French Companie Generale Aeropostale, which operates the air mail service from France to South America, and which, as previously reported in Flight, has been in danger of closing down, are now well on the way to a satisfactory settlement. The whole question of subsidy, etc., is, we understand, being considered by the French Chamber, and meanwhile the services to and from South America are being maintained with their usual success. We hope, very shortly, to publish a fuller statement regarding the position.

Colonial Branches of the G.A.P.A.N.

The Guild of Air Pilots and Air Navigators of the British Empire hopes in time to form branches in the Colonies, and is actively pursuing its endeavours to get a branch formed in Canada, at the request of its members who are out there.



125 IN THE AIR: Among the most unusual aeroplanes at the Paris Show last year was the Bleriot 125, a twin-fuselage, 2-engined monoplane, fitted with two 500-h.p. Hispano-Suiza engines in tandem. The machine carries 12 passengers, 1,200 lb. of luggage, and fuel for 6 hours at cruising speed. The wheels, of the Bleriot resilient type, are partly housed in the fuselage, and are fitted with Palmer brakes.

A Fast Flight

CAPT. HAWKS, whose Travel Air machine is described on page 358, has already distinguished himself in Europe by his fast flight from Cherbourg to Paris and from Brussels to London, and on April 22 he beat all existing times for a flight to Rome. Leaving Heston at 6.26 a.m., he landed at Rome at 11.50, thus making the journey in 5 hr. 34 min., which works out on an average speed of approximately 180 m.p.h. In making the return journey, which he decided to do without delay, he left, after refuelling, at 1.50 p.m.

Inspecting the "Kents"

ON Monday of this week Imperial Airways Ltd. had invited a large party down to Rochester to inspect the three "Kent" flying boats which Short Bros. have built for Imperial Airways services. A large percentage of the members of the party were representatives of the various ticket booking agencies, who thus were afforded an opportunity to see for themselves some of the new aircraft for which they will be selling tickets during the coming season. The party left Victoria station by special train of Pullman carriages, and were conveyed from Rochester station to Short's works by motor coaches. It had been intended that those wishing to do so should be given flights in the second Kent to be finished, and Major Brackley, of Imperial Airways, was to honour the visitors by turning joy ride pilot for the occasion. However, one of the engines refused to start, and moreover the weather was far from favourable, so that the flights had to be abandoned. The visitors were, however, vastly interested by a tour of inspection through the works, where they saw aircraft being produced. The cabins of the new machines were a surprise to those familiar with passenger aircraft, although possibly less so to those visitors who have never seen the lack of comfort usually found in aircraft. In the Short "Kents" an entirely new standard has been set, and the cabin is comparable in comfort and spaciousness with a Pullman saloon carriage.

Australian Air Mail Mishap

JUST as the first experimental air mail between England and Australia, which is being carried out by Imperial Airways, was nearing the end of its objective, one of those annoying mishaps has occurred which slightly upset previously arranged plans. The mail reached Rangoon on April 15 and Singapore next evening, and everything ran smoothly according to schedule until April 19, when, on reaching the island of Timor, strong head winds causing a shortage of petrol, a forced landing had to be made in what appeared to be a nice grass-covered field. The field, however, was not as nice as it looked, with the result that the *City of Cairo* was sufficiently damaged to prevent any question of carrying on to Port Darwin. Fortunately the crew and mails were unharmed, and forthwith arrangements were made for the conveyance of the mails by another machine. Q.A.N.T.A.S., which operates the air mail from Darwin to Brisbane, had no machines suitable for the Timor sea crossing, and so one of the three-engined machines of National Airways was chartered for the salvage work. On April 21, therefore, Air Commodore Kingsford Smith left Sydney—according to some reports, in the *Southern Cross*—en route for Kupang, where he is due to-morrow, Saturday. He will pick up the mails and return on Sunday to Darwin, whence the mails will be conveyed to various points in Australia in accordance with the original programme—it is hoped according to schedule. The return mail will be despatched, as previously arranged, from Port Darwin on April 27, while the second outward mail will leave Croydon on Saturday.

The African Air Mail

IMPERIAL AIRWAYS have been decidedly unlucky with their African Air Mail Service—on the southern portion, at any rate. Further break-down troubles have again delayed this week's mails, and Col. Burchall, assistant manager of Imperial Airways, it is reported, is to fly out to Kisumu to put matters right. Meanwhile the Nairobi Chamber of Commerce has passed a resolution regretting that the Imperial Airways had not completed the experimental stage before inducing the public to use the service. The resolution is being forwarded to the Imperial Airways and the Government, the latter being asked whether it is possible to suspend the subsidy until the service is satisfactory.

Safety in the Air

DR. PIERCY, delivering his second Howard lecture before the Royal Society of Arts on Monday night, April 20, gave figures for the "Silver Wing" service of Imperial Airways to Paris, showing that their factor of the safety, from the passengers point of view, was exceptionally high, and he gave statistics by way of comparison showing that the safety in motor cars was very much lower. Speaking generally, he explained lucidly the factors which govern the safety of an aircraft both structurally from the point of view of design, and he claimed that the pilot himself acted as a safety valve by virtue of the discomfort he experienced when putting undue loads upon the machine and therefore upon himself. He touched lightly on the type of calculation whereby the factors of safety of aircraft are kept very high, and finally gave a clear account of the dynamic safety of the aircraft. Here he explained what occurred when the controls were released and showed that the majority of aircraft are inherently stable.

Brief reference was made to the pros and cons of wood and metal construction, and Dr. Piercy expressed the opinion that the magnesium resources of the Empire should be developed in order that we might use the magnesium alloys to a greater extent than at present. He showed a selection of slides showing different types of aircraft which were designed specifically for safety, and finally another selection which showed different types of metal construction.

In conclusion he dealt with the coming traffic problem, and pleaded for the development of some form of apparatus which would give the pilot a three dimensional sense of vision, since he said he did not think that a pilot's eyes, as they existed to-day, were sufficient to cope with the dangers which would arise when the air became crowded.

Noise

A VERY interesting paper under this heading was read by Dr. A. H. Davis, of the Physics Department, National Physical Laboratory, before the Royal Aeronautical Society on April 16. Pressure on our space prevents us from publishing the paper this week, but we hope to give a fairly extensive summary of it in next week's issue.

"Petrol Engines for Models"

THE Model Aircraft Club (T.M.A.C.) has arranged for an interesting lecture by Mr. Edgar T. Westbury on "Petrol Engines for Models," to be delivered at the Junior Institute of Engineers, Victoria Street, S.W., on May 14, at 7 p.m.

R.A.F. Accidents Per Hours Flown

MAJOR C. C. TURNER, writing in the *Daily Telegraph* of April 18, has, in a very ingenious manner, arrived at the conclusion that in the two years 1929-30 the number of hours flown by R.A.F. machines for each fatal accident was about 10,000. Major Turner explains his method of deduction in the following words:—"In the annual report on the health of the Royal Air Force for 1921-22 the proportion of fatal accidents to flying hours was given. That was the last occasion on which the proportion has been published. But on February 24 this year Lord Trenchard made the following statement: 'If 1929 and 1930 are taken together, the figures are four times as favourable as they were in the two-year period 1921-22.' Now, the figures for this period were: 1921, 2,100 hours; 1922, 3,187 hours—a mean of 2,643 hours per fatal accident. It will be observed that 1922 showed a 47 per cent. improvement over the previous year. That improvement has been almost consistently maintained ever since, and, although the precise figure is not officially published, Lord Trenchard's statement, which, of course, is incontrovertible, shows that in the past two years the number of hours per fatal accident was about 10,000." The above is contrasted with a statement by the French Air Minister in December last that in the French military air service in 1930 there had been one death for every 3,091 hours of flying. There is a possible difference between calculations based on "a death" and those based on "a fatal accident," but even so the margin in favour of the R.A.F. must be very substantial.

Berlin's Aviation Museum

PLANS have been completed for an elaborate museum, to be erected on the Templehof aerodrome land, which will be devoted to aviation alone. This museum—funds for which have been obtained from German and American private sources—will display the whole history of flying, with the originals of the earliest machines, motors and models, and will constitute probably the most comprehensive aviation museum in the world. There will be a court of honour containing busts and portraits of the pioneers of modern aviation, etc., while it is suggested that a restaurant seating a thousand persons, and halls for conferences, should be added. Dr. Eckener has been asked to transfer the Zeppelin museum at Friedrichshafen to the Berlin museum.

CORRESPONDENCE

[The Editor does not hold himself responsible for opinions expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for insertion in these columns.]

"I WILL OBEY."

[2739] It is only a sense of modesty that has delayed my writing an appreciation of the article which appeared in your paper by Daedalus (Dec. 19, 1930), and the answering letter of Sandy McTavish. I had hoped that some of my elders and betters would have taken some notice now that the need had been pointed out to them. One should not, perhaps, even mention in passing that one was surprised that they had to have it pointed out to them. The article really raises three very pertinent questions: (1) Whether there is in fact anybody in civil aviation WHO CAN do anything about it: (2) Assuming that there is, whether they want to and (3) Whether anybody proposes to do anything about it, anyway? The basis of the scheme is quite obviously co-operation between the various members of the civil flying community, but the very word presupposes that there is someone or something with which to co-operate. I myself am not convinced that there is anybody in aviation at the present time who has any vision for the future or plans to cope with its difficulties; nor am I prepared to be put off or snubbed by that much mis-used phrase. "That a great deal is going on quietly"; because, although my experience of flying may not date back so very long, I have sufficient experience in other walks of life to know that in this enlightened age, whether one agrees with the principle or not, you have got to make a great deal of noise before anybody will even hear you, let alone take any notice. Nationally, we measure importance by noise.

One is always diffident, even with the present lead from certain quarters of the Press, in exhibiting signs of sensationalism; but from experience, one is inclined to think that a little out-spoken criticism of civil aviation might literally "clear the air," of misunderstanding. As far as one can make out, the general conception of civil aviation in this country appears to be that it is a form of transport more comparable with the scenic, rather than with the ordinary railway, on the one side, and on the other, the professional who appears to maintain that he and he alone has the whole right of being in the air at all. Leaving for the moment, the question of there being no militant body in civil aviation, one might turn one's attention, to the continual bickering that goes on between the private and professional interests. It is no uncommon thing to find sarcastic paragraphs penned by those people who claim to be well experienced in flying anent lapses on the part of the inexperienced pilot. To say the least of it, it is no encouragement to the private flyer to become anything else than a type of performing flea, and it probably explains in part that on the whole he has very little more airmanship than that somewhat elusive insect. There is no doubt that the amateur pilot very often is an infernal nuisance on recognised air routes, particularly in bad weather; but, after all, there is no mystery in flying, and it is only experience that has brought the professional pilot to the state of safety that he now enjoys. How else can the amateur pilot get his place in the sun? Surely a little advice and help will be far more useful than sarcastic criticism

Nor are the aerodrome officials above criticism, having adapted the Americanism of "air park" with the possible addition of a bar they appear to have exhausted their power of organisation. I know of at least three "control towers" on aerodromes at the present time; for all the notice that is taken of them they might just as well be the Eiffel Tower. Machines land, take off, taxi and perform other less definite evolutions entirely regardless of criticism or discipline. The only explanation that is forthcoming is the half-hearted excuse that the authorities concerned are frightened of losing business.

One would feel happier also if the Royal Air Force would be as careful of our safety in the air in times of peace as I know they would be in times of war.

If luck, that goddess of success, has graced us with her presence in the past when the dangers of flying were for the most part confined to design, let us beware of even giving an impression of discourtesy by insisting, through our own laziness, of her presence, less we find ourselves with a table set for one too many.

If it is a problem for the camel to pass through an eye of a needle, it is as nothing to the task that will lie ahead of us of explaining to a community, incapable of seeing the obvious fallacy of majority rule, the finer points of aviation.

If you will take my advice you will not rely for a solution from those who have so glibly solved the other half of the problem of the rich man entering the Kingdom of Heaven. But perhaps, after all, judging by the efforts at organisation as exhibited by a certain aerial body recently, I have made a mistake in going against the old truism "De mortuis nil nisi bonum." I must blame a sense of helpless depression for misquoting as a signature

London, E.C. 2.
March 19, 1931.

PER ARDUA AD INFINITUM

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AIR MINISTRY NOTICES

AIR MINISTRY NOTICES to Airmen and to Ground Engineers are now sub-divided in the manner, which was explained in FLIGHT for April 17. In view of this rearrangement and also of the increasing size of these notices, these in the future will be published in FLIGHT in summarised form only. Readers will thereby be enabled to see readily what each notice is about and if they should desire to do so, to obtain copies of the particular notices which interest them, from the Secretary, Air Ministry, Gwydyr House, Whitehall, London, S.W.1, or from the Automobile Association, Fanum House, New Coventry Street, W.1.; the Royal Aero Club of the United Kingdom, 3, Clifford Street, W.1; National Flying Services, Ltd., Hanworth Park, Middlesex.

NOTICES TO AIRMEN, SERIES A

No. 11 of 1931. Use of Tri-Coloured Navigation Lights on Aircraft

This authorises the use of two tri-coloured lights, one above the centre section and one below the fuselage of aircraft of less than 60-ft. wing span instead of the usual side and tail navigation lights. Aircraft with a wing span of 60 ft. or over must carry the usual separate navigation lights.

No. 12 of 1931. Civil Air Maps of Great Britain

This is a notification that the following civil air maps of Great Britain are available:—The Ordnance Survey 10-mile map of Great Britain (special air edition) in three sheets, price *5s.* (paper, flat) and *6s.* (linen-backed, folded) per sheet; the ¼-in. Survey map of England and Wales, civil air edition), in 12 sheets, price *2s. 6d.* (paper, flat) and *3s. 6d.* (linen-backed, folded) per sheet; the ¼-in. Ordnance Survey map of Scotland (civil air edition) in 10 sheets, price *2s. 6d.* (paper, flat) and 3s. *6d.* (linen-backed folded) per sheet.

No. 13 of 1931. Danger to Aircraft Arising from Electrical Atmospheric Discharges: Precautions to be taken. (92921/31.)

A case has occurred where serious damage was done to wireless instruments in an aircraft while flying through cloud and sleet with the trailing aerial in use. Users of wireless in aircraft are advised that to safeguard against similar accidents the trailing aerial should be rested up and short circuited to "earth" or in an emergency cut away. Telephones should be disconnected. The wireless set should be switched off.

NOTICES TO GROUND ENGINEERS

No. 26 of 1931. Manufacture and Inspection of Aircraft Parts and Approval of Materials for the Repair or Overhaul of Licensed Aircraft. (80371/31.)

This notice draws the attention of owners and ground engineers to the fact that defective parts have been replaced by others manufactured without reference to drawings. This principle is, of course, not permitted, and certificates of safety should not be made unless the replacement part has been approved by the makers, or manufactured and inspected to standard approved drawings. This notice cancels Nos. 7 of 1922, 21 of 1929, and 1 of 1930.

No. 27 of 1931. "Petroflex" Tubing and Jointing. (80371/31.)

This notice gives a list of precautions to be observed when using "Petroflex" tubing, and cancels Notices Nos. 3 of 1922, and 2 of 1925.

No. 28 of 1931. Maintenance of Aircraft and Engine Log Books and Certification of Overhauls, Repairs, Replacements, etc. (80371/31.)

The heading of this notice is self-explanatory, and it introduces a revised form of Log Book which makes the work of certification easier, and is obtainable from H.M. Stationery Office. Notices Nos. 4 and 20 of 1930 are cancelled thereby.

THE ROYAL AIR FORCE

London Gazette, April 14, 1931

General Duties Branch

The follg. Pilot Officers on probation are confirmed in rank (March 14) :—L. H. Anderson, N. Daunt, W. E. L. Lewis, T. J. MacDermot, R. I. G. MacDougall, B. J. McGinn, P. H. Maxwell, H. A. Simmons, R. G. Wilde.

Wing Commander V. Gaskell-Blackburn, D.S.C., A.F.C., is placed on half-pay list, scale A (April 9) ; Wing Commander G. B. Hynes, D.S.O., is placed on retired list on account of ill-health (April 12).

Medical Branch

Flight Lt. R. J. I. Bell, M.R.C.S., L.R.C.P., is transferred to Reserve, Class D (ii) (April 14).

Chaplains' Branch

The Rev. R. N. Shapley, M.C., A.K.C., is granted a permanent comm. (March 19).

RESERVE OF AIR FORCE OFFICERS

General Duties Branch

The follg. are granted commns. in Class AA (ii) as Pilot Officers (March 30) :—A. L. Holland, W. B. Thompson. The follg. are granted commissions in Class AA (ii) as Pilot Officers on probation (March 31).—J. M. Wells, R. Wynzar. The follg. Pilot Officers on probation are confirmed in rank :—A. W. A. Whitehead (March 24).—J. L. H. Fletcher (March 24) ; J. W. Radbone (March 24) ; A. J. S. Negus (March 26) ; R. Edwards (April 1).

The follg. Pilot Officers are promoted to rank of Flying Officer :—D. J. L. Bryden (Jan. 16) ; C. M. Dransfield (Jan. 27). Flying Officer Philip Booth is transferred from Class AA (ii) to Class C (March 8) ; Flying Officer B. A. Hewett is transferred from Class A to the Special Reserve (Feb. 1) ; Pilot Officer S. Summerfield relinquishes his commn. on completion of service (March 23).

AUXILIARY AIR FORCE

General Duties Branch

No. 600 (City of London) (Bomber) Squadron.—Flying Officer G. de H. Vaizey resigns his commn. (April 2). No. 603 (City of Edinburgh) (Bomber) Squadron.—Squadron Leader J. McKelvie, A.F.C., relinquishes his commn. on completion of service (Feb. 1); H. R. Murray-Philipson to be Squadron Leader and to command the Squadron (April 14).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified :—

General Duties Branch

Group Captains : G. R. S. Bradley, O.B.E., to R.A.F. Depot, Uxbridge, on relinquishing the appointment as Air Attaché, Rome, 21.3.31. A. S. Barratt, C.M.G., M.C., to No. 1 (Indian) Group, Peshawar, pending taking over command, 2.4.31.

Wing Commander C. W. H. Pulford, O.B.E., A.F.C., to Station H.Q., Bircham Newton, pending taking over command, 9.4.31.

Squadron-Leaders : S. R. Watkins, A.F.C., to No. 500 Sqdn., Manston, 30.3.31. D. F. Lucking, to Marine Aircraft Experimental Estab., Felixstowe, 27.3.31.

Flight-Lieutenants : F. V. Beamish, to No. 25 Sqdn., Hawkinge, 20.3.31. P. Hill, to No. 40 Sqdn., Upper Heyford, 1.4.31. C. Chapman, D.S.C., to No. 54 Sqdn., Hornchurch, 2.4.31. B. A. S. Lewin, to No. 10 Sqdn., Boscombe Down, 1.4.31. L. B. Duggan, to R.A.F. Training Base, Leuchars, 7.4.31. F. W. Moxham, to Station Headquarters, Northolt, 30.3.31. C. C. Edwards, to No. 1 School of Tech. Training (Apprentices), Halton, 31.3.31. H. L. Patch, to Station H.Q., Bircham Newton, 9.4.31. W. H. Poole, A.F.C., M.M., to No. 45 Sqdn., Helwan, Egypt, 23.3.31. J. F. T. Barrett, D.S.O., D.F.C., to No. 84 Sqdn., Shaibah, instead of to No. 1 Armoured Car Company, as previously notified, 10.3.31. C. S. Cadell, to Electrical and Wireless School, Cranwell, 13.4.31. H. P. G. Leigh, R. H. S. Spaight, both to R.A.F. Depot, Uxbridge, 25.3.31. I. A. Bertram, to R.A.F. Depot, Uxbridge, 16.3.31. O. E. Carter, R. T. Taaffe, both to R.A.F. Depot, Uxbridge, 7.3.31.

Flying Officers : J. McGuinness, to No. 101 Sqdn., Andover, 7.4.31. J. C. B. Tinling, to R.A.F. Base, Calshot, 1.4.31. A. C. Bailey, to No. 40 Sqdn., Upper Heyford, 1.4.31. C. Sarsfield-Sampson, to No. 1 Armoured Car Company, Hinaidi, 22.3.31. M. N. Oxford, to No. 55 Sqdn., Hinaidi, instead of to No. 30 Sqdn., Mosul, as previously notified, 10.3.31. J. E. Loverseed, to No. 208 Sqdn., Heliopolis, instead of to No. 6 Sqdn., Ismailia, as previously notified, 10.3.31. S. H. Bell, to No. 84 Sqdn., Shaibah, instead of to No. 30 Sqdn., Mosul, as previously notified, 10.3.31. B. G. Farrow, W. D. Butler, P. Kinsey, all to Elec. and Wireless School, Cranwell, 13.4.31. P. J. Bett, M. R. Edmondes, R. G. Hennessy, D.S.O., M.C., all to R.A.F. Depot, Uxbridge, 25.3.31. R. H. C. Taylor, to Armament and Gunnery School, Eastchurch, 7.3.31. U. S. Mackay, to R.A.F. Depot, Uxbridge, 7.3.31.

Pilot Officers : N. V. Bertram, to No. 12 Sqdn., Andover, 30.3.31. E. A. Kayser, to No. 56 Sqdn., North Weald, 27.3.31. R. B. Lees, to No. 29 Sqdn., North Weald, 27.3.31. A. W. S. Matheson, to No. 19 Sqdn., Duxford, 27.3.31. V. A. Dawson, to No. 40 Sqdn., Upper Heyford 1.4.31. J. Bamber, to School of Photography, S. Farnborough, 9.3.31.

Stores Branch

Squadron-Leader V. J. B. Jacobs, to R.A.F. Depot, Uxbridge, 25.3.31.

Flight-Lieutenants : R. A. Young, to Station H.Q., North Weald, 7.3.31 H. E. Tansley, M.C., to R.A.F. Depot, Uxbridge, 21.3.31.

Flying Officers : T. A. Head, to R.A.F. Depot, Uxbridge, 23.3.31. C. L Gilbert, to No. 28 Sqdn., Ambala, India, 14.3.31.

Accountant Branch

Squadron-Leader W. G. W. Prall, to R.A.F. Depot, Uxbridge, 7.3.31.

Flight-Lieutenants : J. M. Adams, R. T. Carter, J. Charles, all to R.A.F. Depot, Uxbridge, 25.3.31.

Flying Officers : A. L. Derry, to Station H.Q., Hal Far, Malta, 1.4.31. C. Lorimer, to R.A.F. Depot, Aboukir, Egypt, 23.3.31. H. C. Bakes, to No. 2 Armoured Car Company, Ramleh, 23.3.31. H. Crowther, to R.A.F. Depot, Uxbridge, 21.3.31.

Medical Branch

Flight-Lieutenant G. Kinneir, to Anti-Aircraft Co-operation Flight, Biggin Hill, on appointment to a temp. commn., 7.4.31.

Chaplains Branch

Rev. H. Thomas, to No. 4 Flying Training School, Abu Sueir, Egypt, 23.3.31.

NAVAL APPOINTMENTS

The following appointments have been made by the Admiralty :—

Lieutenant (Flt.-Lieut., R.A.F.).—R. G. Poole, to *Glorious* (May 4).

Lieutenants (F.O., R.A.F.).—I. M. Martineau, G. R. Maw, B. H. M. Kendall, and A. C. R. Duvall, to *Glorious* (May 4) ; J. de F. Jago and G. B. Kingdom, to *Glorious* ; J. Brett and D. J. Margett, to *Victory* (April 7).

Sub-Lieutenant (F./O., R.A.F.).—T. W. T. Blackwell, to *Glorious*.

Lieutenant (Flt.-Lieut., R.A.F.).—R. G. Poole, to rank of Lieut.-Commr. (seny. April 15).

Lieutenants (F./O., R.A.F.).—H. Ditton and E. W. E. Lane, to rank of Lieut.-Commr. (seny. April 15).

◈ ◈

Re-equipping R.A.F. Squadrons

The Air Ministry states that, as far as can be foreseen at present, the following are the approximate dates on which new types of aeroplanes will be supplied during the next few months :—

Type.	Unit.	In replacement of	Approximate Date.
Atlas A.C. ..	Communication Flight, Andover	Bristol Fighter..	April, 1931.
Atlas A.C. ..	Station Flight, Duxford	Bristol Fighter..	April, 1931.
Atlas A.C. ..	School of Photography, Farnborough	Bristol Fighter..	May, 1931.
Atlas A.C. ..	R.A.F. Depôt, Aboukir	Bristol Fighter..	June, 1931.
Fairey IIIF (F.A.A.)	No. 449 Flight ..	Blackburn ..	May-June, 1931.
Hart (Fighter)	No. 23 Squadron (one flight)	Gamecock ..	May, 1931.
Nimrod ..	No. 402 Flight ..	Flycatcher ..	June, 1931.
	Base Training Squadron, Gosport	—	July, 1931.
	Base Training Squadron, Leuchars	Flycatcher (1 IE)	July, 1931.
Fury ..	No. 43 Squadron ..	Siskin ..	April, 1931.
Gordon ..	No. 40 Squadron (new squadron)	—	April, 1931.
Ripon ..	No. 466 Flight (new flight)	—	April, 1931.
Wapiti(VIII)	India (Squadron) ..	Bristol Fighter..	Shipped during April, 1931.

Officers for Permanent Commissions or Medium Service

The following officers have been selected for permanent commissions (subject to physical fitness) or medium service, as indicated :—

Permanent Commissions

Flying Officers.—Gilbert Bartholomew, John René Whitley.

Medium Service

Flight Lieutenants.—*Ernest James Howes, Henry Eustace Power, Cyril Walter.

Flying Officers.—*Patrick John Bett, Ronald William Macdonald Clark, Harold Basset Collins, Peter Dicken Cracroft, Bertram Arnold James Crummy, Thomas Harold Downes, John Goodenough Elton, Morgan Griffiths, Herbert George Hicks, Miles Roy Kelly, John Bruce Knapp, George Peter Macdonald, Harold Claude Marett, Jack Eugene Markby, Lionel George Martin, James Francis Moir, *Frederick William Murison, Richard Rupert Nash, Ernest Leslie Jack Rowe, Geoffrey Howard William Selby-Lowndes, Arthur Montague Stevens, Alexander Edward Taylor, Frederick John Taylor, Wilfred Peter John Thomson.

The selection of the officers marked "*" is subject to the approval of the War Office.

R.A.F. SPORT

Inter-Services Golf

The R.A.F. beat the Army in the Inter-Services golf championship at West Hill on Thursday, April 16, by 6 matches to 5. The golf was of a high standard throughout, and the result depended on the last match to be played. Squadron Leader A. E. Barr-Sim won this match from Mr. H. R. Beauchamp by holing a yard putt on the 18th green.

The results were :—

FOURSOMES.

Royal Air Force.		The Army.	
Pilot Officer W. R. Wills-Sandford and Flying Officer G. F. Humphries (halved)	0	Captain G. A. Moxon and J. V. C. Moberly (halved) ..	0
Flight-Lieut. G. R. Beamish and Squadron Leader A. E. Barr-Sim (3 & 2)	1	N. R. Reeves and Major W. M. Ozanne	0
Flying Officer W. F. Pharazyn and Flying Officer A. Laws	0	H. R. Beauchamp and Captain G. E. Hawkins (4 & 3) ..	1
Squadron Leader C. R. Davidson and Flight-Lieut. J. Silvester ..	0	C. L. Gordon-Steward and Captain H. S. Lewis Barclay (4 & 3)	1
Total	1	Total	2

SINGLES.

Wills-Sandford (2 & 1)	1	Moxon	0
Humphries (2 & 1)	1	Moberly	0
Beamish	0	Reeves (2 & 1)	1
Barr-Sim (1 hole)	1	Beauchamp	0
Pharazyn	0	Gordon-Steward (6 & 5)	1
Laws (7 & 6)	1	Ozanne	0
Silvester	0	Hawkins (2 holes)	1
Davidson (3 & 2)	1	Lewis Barclay	0
Total	5	Total	3

AIRCRAFT COMPANIES' STOCKS AND SHARES

DESPITE the reactionary tendency of the stock and share markets under the influence of Budget uncertainties, the shares of aircraft and associated companies have maintained a satisfactory tone during the past month. The recovery in De Havilland ordinary has continued, aided by favourable references to the company's machines. There has been a rise during the month from 19s. 7½d. to 21s. 10½d. Fairey Aviation ordinary were a shade lower. Handley Page participating preference were again active, but are little changed on balance. Some market men are budgeting for a dividend of 100 per cent. on the privately-held ordinary in which case the dividend on the participating preference would be raised from 12½ per cent. to 13¾ per cent. Petters' ordinary have risen a few pence, and the preference also improved. The company's year closed on March 31, and the report is due in July. For the previous year the dividend was raised from 6 to 7 per cent. Imperial Airways' ordinary moved up 6d., the accelerated London-Paris service and other developments being regarded favourably. An interesting feature was the marking of better prices for National Flying Services' ordinary. The view seems to be gaining ground that the additional capital provided by the debenture issue has materially improved the company's position, although ordinary dividends may yet be a long way ahead. Rolls-Royce ordinary are lower on balance; the set-back in profits for the past year is, however, relatively unimportant, for earnings still show a margin of nearly 5½ per cent. over the conservative distribution of 10 per cent. The accounts drew attention to the strong balance-sheet; at the meeting it was stated that further foreign orders for aero engines are anticipated. Vickers' ordinary held their rise, aided by the full accounts and meeting, but later came under the market tendency to lower prices. They are now quoted x.d. at 7s. 3d. "middle." D. Napier & Son's ordinary were fairly well maintained, having regard to the chairman's cautious remarks at the meeting; they are "ex" the final dividend which was paid on the 17th inst.

Name.	Class.	Nominal Amount of Share.	Last Annual Dividend. %	Current Week's Quotation.
Anglo-American Oil	Deb.	Stk.	5½	99¼
Armstrong Siddeley Develop. ..	Cum. Pref.	£1	6½	16/3
Birmingham Aluminium Castg.	Ord.	£1	7½	20/-
Booth (James), 1915	Ord.	£1	15	42/- xd
Do. do.	Cum. Pref.	£1	7	22/6
British Aluminium	Ord.	£1	10	30/- xd
Do. do.	Cum. Pref.	£1	6	20/- xd
British Celanese	Ord.	10/-	Nil	7/-
British Oxygen	Ord.	£1	8 B	17/-
Do. do.	Cum. Pref.	£1	A	21/9
British Piston Ring	Ord.	£1	22½	29/-
British Thomson-Houston ..	Cum. Pref.	£1	7	23/10½
Brown Brothers	Ord.	£1	10	24/9
Do. do.	Cum. Pref.	£1	7½	23/-
Dick (W. B.)	Cum. Pref.	£10	5	5 13/16
De Havilland Aircraft ..	Ord.	£1	5	21/10½
Dunlop Rubber	Ord.	6/8	15	12/1½
Do. do.	"C" Cum. Pref.	16/-	10	20/10½
En-Tout-Cas (Syston) ..	Def. Ord.	1/-	Nil	1/4½
Do. do. ..	Ptg. Pfd. Ord.	5/-	8	4/5¼
Fairey Aviation	Ord.	10/-	7*	12/6
Do. do.	Ist. Mt. Deb.	Stk.	8	106½
Firth (T.) & John Brown ..	Cum. Pref.	£1	6	11/-
Do. do. ..	Cum. Pref.	£1	5*	12/-
Ford Motor (England) ..	Ord.	£1	10	58/7½
Fox (Samuel)	Mt. Ptual. Deb.	Stk.	5	72½
Goodyear Tyre & Rubber ..	Deb.	Stk.	6½	100¼
Handley Page	Ptg. Pref.	8/-	12½	11/3
Hoffmann Manufacturing ..	Ord.	£1	Nil	18/9
Do. do. ..	Cum. Pref.	£1	7½	15/3
Imperial Airways	Ord.	£1	5	17/-
Kayser, Ellison	Ord.	£5	6	60/-
Do. do.	Cum. Pref.	£5	6	77/6
Lucas (Joseph)	Ord.	£1	25	66/- xd
Napier (D.), & Son	Ord.	5/-	15	8/1½ xd
Do. do.	Cum. Pref.	£1	7½	22/6
Do. do.	Pref.	£1	8	22/6
National Flying Services ..	Ord.	2/-	Nil	-/8½
Petters	Ord.	£1	7	21/9
Do.	Cum. Pref.	£1	7½	18/1½
Roe (A. V.) (Cont. by Armstrong Siddeley Devel., *q.v.*)	Ord.	£1	—	—
Rolls-Royce	Ord.	£1	10	34/6
Smith (S.) & Sons (M.A.) ..	Def. Ord.	1/-	18¾	1/9
Do. do.	Ptg. Pfd. Ord.	£1	12½	17/6
Do. do. ..	Cum. Pref.	£1	7½	17/9
Serck Radiators	Ord.	£1	17½	35/-
"Shell" Transport & Trading	Ord.	£1	25*	58/9
Do. do. ..	Cum. Pref.	£10	5	10 xd
Triplex Safety Glass	Ord.	£1	5	27/-
Vickers	Ord.	6/8	8	7/3 xd
Do.	Cum. Pref.	£1	5*	18/4½ xd
Vickers Aviation (Cont. by Vickers, *q.v.*)	—	—	—	—
Westland Aircraft (Branch of Petters, *q.v.*)	—	—	—	—
Whitehall Electric Investmts.	Cum. Pref.		7½	24/7½

A Issued in January. * Dividend paid tax free.
B Rate per annum for nine months.

IMPORTS AND EXPORTS

AEROPLANES, airships, balloons and parts thereof (not shown separately before 1910).

For 1910 and 1911 figures see FLIGHT for January 25, 1912.
For 1912 and 1913, see FLIGHT for January 17, 1914.
For 1914, see FLIGHT for January 15, 1915, and so on yearly, the figures for 1930 being given in FLIGHT, January 16, 1931.

	Imports.		Exports.		Re-exports.	
	1930.	1931.	1930.	1931.	1930.	1931.
	£	£	£	£	£	£
Jan. ..	2,987	7,965	147,935	142,596	—	1,074
Feb. ..	2,460	3,303	226,049	110,587	1,000	1,293
Mar. ..	744	5,615	156,098	83,088	802	3,441
	6,191	16,883	530,082	336,271	1,802	5,808

PUBLICATIONS RECEIVED

Preparing for Aviation: An Introductory Course. By Lieut. V. C. Finch, U.S.N. (ret.). New York: Simmons-Boardman Publishing Co.; London: Simpkin, Marshall, Ltd. Price 20*s.* net.

Workshop Notes on the Condor Engines, Series III A, III B, and III B HS. Air Publication 1343 (Part II). H.M. Stationery Office, Kingsway, London, W.C.2. Price 3*s.* net.

U.S. National Advisory Committee for Aeronautics Reports. No. 356. *Strength of Rectangular Flat Plates under Edge Compression.* By I. Schuman and G. Back. Price 15 cents. *No.* 362. *An Extended Theory of Thin Airfoils and Its Application to the Biplane Problem.* By C. B. Millikan. Price 20 cents. *No.* 364. *The Pressure Distribution over the Wings and Tail Surfaces of a PW–9 Pursuit Airplane in Flight.* By R. V. Rhode. Price 60 cents. *No.* 365. *Aerodynamic Characteristics of Circular-Arc Airfoils at High Speeds.* By L. J. Briggs and H. L. Dryden. Price 10 cents. *No.* 366. *Dynamic and Flight Tests on Rubber-Cord and Oleo-Rubber-Disk Landing Gears for an F 6C–4 Airplane.* By W. C. Peck. Price 10 cents. *No.* 367. *Pressure Distribution over a Thick, Tapered, and Twisted Monoplane Wing Model.* N.A.C.A. 81–J. By C. J. Wenzinger. Price 10 cents. No. 371. *Present Status of Aircraft Instruments.* Price 15 cents. Superintendent of Documents, Washington, D.C., U.S.A.

AERONAUTICAL PATENT SPECIFICATIONS

(*Abbreviations*: Cyl. = cylinder; i.c. = internal combustion; m. = motors. The numbers in brackets are those under which the Specification will be printed and abridged, etc.)

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